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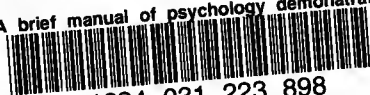
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A BRIEF MANUAL OF PSYCHOLOGY DEMONSTRATIONS

MAX F. MEYER

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A BRIEF MANUAL
OF
PSYCHOLOGY
DEMONSTRATIONS

TO ACCOMPANY AS ILLUSTRATIVE MATERIAL
AN ELEMENTARY COURSE

IN
THE PSYCHOLOGY OF THE OTHER-ONE

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PREFACE

This book has not been entitled either "psychological experiments" or "psychological laboratory exercises" because it does not offer either that which is impossible or that which but few college students need.

It is impossible to teach anybody how to open up—by experiment, like a Galileo—into an unexplored region of the world new avenues of understanding. One can "teach" only that which is "already known." Experiments can not be taught. They must be invented.

To teach—thru exercises—how to take measurements by the skilful use of existing apparatus, is indeed possible. But the demand for that instruction in measurement is relatively small among beginners, in psychology as in any science. And for advanced students who specialize in psychology there is no dearth of good laboratory manuals.

This book is not intended to be used alone, but only as an auxiliary—and a rather essential auxiliary—to the author's text-book, *Psychology of the Other-One*.

No text-book in any science can rely totally on the student's ability to illustrate the theories taught—and a text-book ought to teach scientific theories!—by using as illustrative material only his previous life experience. Therefore graphic illustrations are used in texts and demonstrations in class rooms.

It is well known, for example, in anatomy, that the demonstrative value of a dissection is greater when the

student applies his own hands than when he is a mere onlooker at a dissection made by the demonstrator.

This book will help that student who uses the author's introductory text, to apply his own hands to the demonstration of certain not quite ordinary experiences with other people (not with his consciousness). No demonstration has been included merely because of its value as a curiosity. No illusion is included merely because it is an illusion. All these demonstrations illustrate and thereby further clarify the theories of which the text is composed. Any demonstration which has no such definite relation, has been rigorously excluded no matter how much the omission may hurt the book in the eyes of him who looks for "what is customarily included."

Like the *Psychology of the Other-One* this book is written for the use of college freshmen and shows incidentally with what aims the elementary (beginners') course in psychology has been taught in the University of Missouri for more than two decades.

MAX F. MEYER

The University of Missouri

Introductory Advice.

The student should, at the beginning of the course in the Psychology of the Other-One, choose a partner on whom to make the demonstrations enumerated below. It is true that he can make some of these demonstrations on his own body, asking himself the questions and answering them himself. For example, working with the color-wheel, he can ask himself whether the disk deserves to be called colorless. But he can not easily measure his own reaction time or run a maze and at the same time keep the records required.

All the demonstrations given here can, and preferably should, be made on the Other-One. This is not a course in introspective psychology. The famous warning "Know Thyself" really means: Know the other fellows, including in this knowledge the opinion which they hold of you.

In making the demonstration, follow the advice given in this manual; but also compare the text-book; and whenever you have exhausted your resources, do not hesitate to ask the instructor's advice. He is not your enemy.

In writing up your demonstrations, use common sense. Avoid unnecessary words. But write—make this your standard to judge by—enough to feel satisfied that if you should read your notes again after a year's interval, the whole demonstration would again be clear to you. Remember,—be brief. That epoch is past when teachers

based the marks they gave to students on the weight of the paper filled by them during an examination period. You will be graded on the basis of tests proving what you have accomplished, not on *how much* you have written in your note book or on a test paper. Do not copy in your note book sentences from this manual or from your text.

Do not misunderstand what has just been said as meaning that you should abstain from writing when you study. On the contrary, no better advice can be given to you than to answer the questions which you find printed in the back of the text-book, not only orally, but in writing.

I. *The Time of a Reaction, Simple or Choice.*

The reaction time is recognized to be one of the most fundamental facts with which the psychology student must be familiar. In order to familiarize yourself with it, you will measure your partner's reaction time in the case of a simple reaction and also in the case of a choice reaction.

When reading of "choice," do not think of anything subjective like a power of the soul or a mysterious entity like the one represented by the "deus ex machina" on the Greek stage. Choice means that the stimulation, and with it the response, "varies from time to time," as you will vary it here.

There are very many time measuring instruments which have been invented for the measurement of durations of time from a few seconds down to a thousandth part of a second. That instrument which you will use here was invented by Professor Sigmund Exner of the

University of Vienna and called by him "neuramebi-meter," that is, "nervous flux recorder." See sketch on page 46 of your text.

This instrument measures the reaction time in hundredths of a second. It is very simple, fairly fool-proof, and gives you a chance to learn incidentally about the method of registering a momentary event by a mark made on a smoke covered and moving surface.

Take out the glass slide and smoke it on its proper surface over a candle. After taking one record, you remove the glass again and reinsert it with ends exchanged, so that one smoking will permit you to record two reaction times. After that you wipe the glass clean with a towel. In order to smoke the glass, take one end between your fingers, touching with your fingers the ground edges and thus leaving the surface to be smoked virtually free. Steadily move the glass in a quick motion lengthwise back and forth thru the flame. Remember "move." Do not hold it still. You do not want to heat the glass and burn your fingers. Be patient and soon you will see the surface covering itself with a uniform gray layer of fine soot. Then take hold of the other end and smoke the place which (in order to save your fingers) you have not yet moved thru the flame.

Remember "thru the flame," not above the flame. But do not touch the wick, or you will get candle grease on the glass. Remember "gray." You do not want the glass black, for you do not want to provide more work for the laundry than is unavoidable.

When the smoked glass slide is in place, with the vibrating spring bent sidewise and resting against the big pin, see to it that the writing point has neither too much nor too little friction on the glass.

Now seat your partner comfortably on a chair (sit down yourself, too) and tell him to touch (not to weight) the button with the index finger of his better hand. Make him close his eyes and instruct him to press down the button with the greatest possible speed as soon as he hears the rather low and dull tone of the vibrating reed, the big steel spring. Give him first a little practice in doing this, before inserting the smoked glass, and thus without taking any record.

When you pull the hook, be sure that you hold it firmly between the index finger and the thumb. Practice it, pulling the whole slide entirely from its bearings. It must then be securely held by you in the air and not drop on the floor.

Next to the glass the most breakable part of the instrument is the tiny spring point which writes on the smoked surface. Never move the slide *backwards* without being sure that this point is safe (button down) while you push the slide back.

You do not want ever to surprise your partner. We do *not* in psychology demonstrations play *tricks* on each other any more than we use *magic*. Therefore, two or three seconds before pulling the hook (varying this time a little) you say "Ready," so that he may get ready and avoid surprise.

If you do not know how long two or three seconds last, look at the pendulum of the laboratory clock. It swings from one side to the other in about two-thirds of a second. Three swings make two seconds, six swings four seconds, and so forth.

Test your partner and count the number of waves in the smoke. Each wave, from valley to valley, lasts one

hundredth of a second. If the last visible wave is incomplete, count it one provided you see more than one-half of it. If less, do not count it.

If you count less than ten waves, disregard that test. Either one of two possible mistakes has occurred. Your partner, instead of reacting to the tone signal, may simply have become impatient with watchful waiting after hearing you say "Ready." Or your partner did not follow your order barely to *touch* the button, but *weighed* his hand on it, letting it rely on the friction between the big spring and the pin. As soon as you begin to pull, that friction changes from rest friction to motion friction. The latter, as you learn in physics, is very much less powerful. Therefore now by mere gravity your partner's hand and arm (even if—imagine—they had been cut off at the shoulder) would push the button down. But you do not want to measure the reaction time of *gravity* working against friction. A normal human reaction time can not be reduced to less than ten hundredths of a second.

Take fifteen tests. Write down in your note book the fifteen numbers counted as well as their average. Learn at this time that you will never find men of science satisfied with being told an average alone, without any indication of how those actual test values varied from which that average was computed. Don't use decimals in computing the average. Choose the nearest integer.

If you are interested in knowing how you could save paper space by substituting for the many test values a mere statement of the average deviation, ask the instructor how to compute that deviation. But this is not required.

Now ask your partner what average reaction time he found when he tested you. Notice how *people* may differ.

After having thus measured your partner's simple reaction time, measure his time of a choice reaction. Proceed in exactly the same way as with the simple reaction time, with the following additions and exceptions.

Put the index finger of his second best hand on the button of a contact key which will cause the striking of a gong when the button is pushed down. Then instruct your partner to get ready to react with either hand, but to react with the second hand alone whenever you say "Gong" and with the best hand alone whenever you say "Noo" (for neuramebimeter).

Make for your own use, secretly, a list of fifteen times the word "gong" and fifteen times the word "noo," mixed at random.

Pronounce your word very quickly and very distinctly at the very moment when you pull the hook. You may have to pull the slide now *more slowly* than in taking the simple reaction time, and you may have to pull it *clear out* of its bearing in order to get all the waves written on it.

When you hear the gong striking altho you did not say "Gong," make a cross in your list indicating an error.

If your partner should raise the writing point of the neuramebimeter and thereby interrupt the wave line altho you did not say "Noo," save the time of counting the waves. Simply make an error cross in your list.

You are likely to get fewer than fifteen correct reaction times. But they will suffice for this demonstration.

Ask your partner, for comparison, what average choice reaction time he found when he tested you, and also what number of errors he found with you. Notice first, whether all people are equally fast; and second, whether they are equally apt to fall into errors.

II. *The Formation of a Multiple Habit of the Serial Type.*

Warning: Do not go about in the laboratory looking at the mazes used by other pairs of students. Seeing them spoils your own work completely.

Our text (p. 124) has taught us that all types of habit formation can be reduced to one simple and fundamental type. Two stimuli must be applied with no great time interval between them. (The longer that interval, the weaker the habit: "10 seconds stimulation interval"—"very weak effect.") Remember: there are always *two* stimuli.

The two (complex) nervous currents are served by a *longer and common* path. Each of the currents is also served by a *shorter* path which each of the two functions (either reflexes or old habits) possesses separately from the other function. The habit *formation* consists in the *reduction of the resistance of that longer and common path*. Compare the figure of page 124 of your text.

The change occurring in the nervous system, as described in the text more fully, can be stated in brief and more abstract form as follows, in two stages (which, however, are not successive in fact).

Warning: Do not confuse "susceptibility" with "conductivity." Consult the index of your text.

First Stage.

Condition: The black lines suffer a double influence because of the double stimulation.

"Limit" which this influence approaches (tho never reaches): The resistance of the black lines approaches zero.

Conclusion: A current coming from S_a now divides (with ever increasing approximation) in halves, that is, equally, at S_a^1 .

Assumption made previously on broader grounds than the present necessity: The "higher" neuron $S_a^1 S_{ab}^2$ is more susceptible than the "lower" neuron $S_a^1 M_a^1$.

Total Conclusion: Finally all the current would go from S_a^1 upwards to the higher center. Nothing then goes from S_a^1 to the right. (Psychology of the Other-One, page 127, line 4.)

Second Stage.

Condition: The double stimulation is always applied more strongly at S_b than at S_a .

Conclusion: The resistance from M_{ab}^2 to M_b is more quickly reduced than the resistance from M_{ab}^2 to M_a .

Final Conclusion: Most (or all) of the current from separate stimulation of S_a now goes (I) from S_a^1 upwards and (II) from M_{ab} down to the right, to M_b . (Psychology of the Other-One, page 127, line 6.)

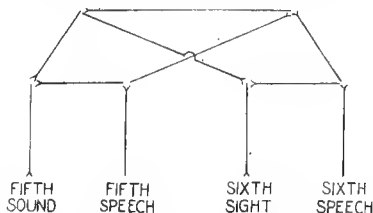
It is self-evident that the changes in the nervous system here in question must be the greater, the stronger and the longer the stimulation. Many stimuli either can not be strengthened or cannot be prolonged without ceasing to be what they are to be. For example, a word

sound can not be prolonged to last a minute,—that would no longer be that word but a howl. Length of the stimulation then can be secured only by frequent repetition of the stimulus. But the student must remember that the *total duration* of the stimulation is here the determining factor. There is no such thing as a fundamental “law of frequency” in habit formation. That is only a corollary of the condition of length.

Neither is there any such thing as a fundamental “law of effect” in habit formation, altho it has spooked for years in many psychology texts. Quite apart from the fact that an explanation by *effect* would be *teleology*, since *science* explains by *causes*,—that “law of effect” is only a corollary of the condition that there must be *two* sensory-motor functions (reflexes or old habits). One stimulus alone cannot create a variation of its response. The second response, that contained in the second sensory-motor function, really is what those texts vaguely refer to when talking of “the effect.”

A simple habit like the one represented by the figure on page 124 of the text is acquired *by human beings* so quickly that the process of forming the habit can not easily be demonstrated as being a particular “function of time.” With animals this demonstration is possible even in a simple habit. But our fellow men interest us more than animals. Experiments to discover what that mathematical “function of time” was, were therefore first made—by Ebbinghaus—on multiple, not on simple habits. The experiments by Ebbinghaus on the formation of multiple speech habits are now regarded as classic. He learned to recite a series of ten or twenty nonsense syllables and thereby determined “the learning curve.”

Remember, that the only reason why, in determining the learning curve, one did not experiment with a single simple speech habit, was the fact that in a human being such a habit is often acquired in "no time."



Use the figure to make clear to yourself that learning a series of nonsense syllables is nothing other than a multiple habit.

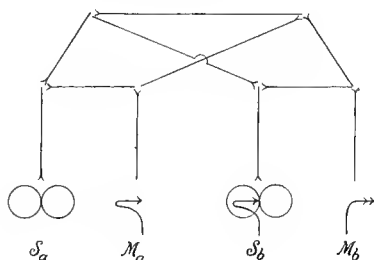
The fifth word-sound is most readily responded to by pronouncing the fifth word; but there is the sight of the sixth word which is responded to by the pronunciation of the sixth word. The sentence just finished describes the process of habit formation.

As soon as the habit is strong enough, the two middle ones of the four external factors have dropped out completely. As long as they have not dropped out completely, the habit is still weak.

The habit in its full strength functions with only the first and fourth external factors. That is, the fifth word-sound is directly responded to by the pronunciation of the sixth word.

(Look at the figure!—At the beginning of the series, substitute "first" for "sixth" in the third and fourth factors. Substitute in the first and second factors "invitation sound" for "fifth sound" and "restating the invitation sound" for "fifth speech.")

Experiments to discover the time function for multiple habits of actions other than speech actions have been made in later years especially in America, most frequently by letting an animal run a maze. You will demonstrate here the formation of a multiple habit by letting your partner run a maze.



Look at the figure!—You see there the first factor indicated by a double circle. This double circle is used as a symbol for a situation presenting, after various previous maze turns and splits, more than one possibility of proceeding in locomotion. You can now proceed by taking either the continuation to the right or that to your left. If there is anything in the situation which determines your taking the good tunnel, there is nothing further to say.

If you take the bad tunnel, you run into a blind alley which turns you back to its own entrance. The symbol indicating the second factor in the figure represents your action of entering and leaving behind that blind alley.

The third factor is indicated by a composite of the symbols of the first two factors. That is, the stimulation consists of the splitting tunnel plus “the stimulation

resulting from'' (popularly speaking, ''the experience of'') going into and out of the blind alley.

The fourth factor is indicated in the figure by a curve bending in the other direction, leading to a double arrow head, which reminds us of the possibility of unblocked progress.

The last four paragraphs together describe the process of habit formation. The habit in its full strength functions with only the first and fourth external factors. That is, the situation—of meeting, after various previous maze turns and splits, this split of the tunnel—is now directly responded to by taking the turn into the good tunnel.

After having made all this clear to your partner, you ask the instructor to give you one maze and your partner a different maze. No pictures of these mazes are shown in this manual because—you remember—seeing the mazes in advance spoils your demonstration. One of these mazes is a famous plaything of royalty, the so-called Hampton court maze, but with some modifications. All the shunts have been converted into blind alleys. You then have nine different habits to form in order to run the maze without being lured into any blind alleys. The other maze is of a design that has been used frequently for experiments with animals. You have to form sixteen different habits in order to avoid all the blind alleys.

You now place your maze well covered with a cloth before your partner. Your partner places his maze well covered before you.

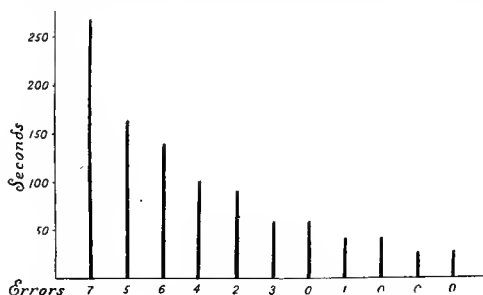
If you want to look at your maze, do not uncover it without being sure that your partner will not see it. You have to uncover it in order to write down in your

note book first a column of numbers from 1 to 16 (or to 9) and then to the right of each number in a second column the letter R or L, according as the good turn is either right or left. In a further column (you must provide for several more) you will later make a *cross* whenever you see your partner make a *bad* turn.

Now get your watch ready, make your partner close his eyes, uncover your maze, put his finger in the center, and when you like the position of the hands of your watch, say "Start."

At the instant your partner drops out of the maze, note down the time. Then cover your maze and only then permit him to open his eyes.

Now convert minutes and seconds all into seconds and write that number above the proper column. Below the



column write the number of crosses, that is, bad turns, errors. You need these entries, because at home you will make a graph of the running of your maze by your partner, like the sample shown.

You now take a rest by letting your partner make you run his maze once.

Then you make him run your maze once again; and so on alternately until you have seen your partner run your maze without an error three times in succession.

Answer this question: Why does the preceding paragraph insist upon *three* times in *succession*? Why is "once without an error" not enough to stop? Discuss then, the demonstration being finished for both, with your partner the questions whether he is more clever than you or the reverse, and whether one of the mazes is more difficult to run than the other. (Both mazes are now open to your inspection.)

You must after that—you should not do it before—ask the instructor whether with animals one kind of maze has been found to be easier than the other.

If your previous conclusion seems to be discrepant with his answer, read chapter XVII of your text in order to straighten the matter out.

Finally compare your learning curve with the learning curve on page 132 of your text. Tell whether it is the same or a different type of curve; and what makes it either alike or different.

III. *The Threshold in Estimating Weights.*

First Part

It often happens in life that you have to apply your body to something multiple which, from case to case, becomes either increasingly difficult or increasingly easy. With increasing difficulty, it is clear that you should then pass *thru* some cases where you say "It is more or less guess work." Those cases you call the "threshold." You are, so to speak, *passing out* of the chamber of success. But you have not yet left that chamber behind

you,—you are still “on its threshold.” Passing to further cases in the same direction, it becomes “a *mere* guess.” The chamber of success now is at a distance: You have left behind you the threshold, figuratively.

Going from case to case in the other direction, too, you pass thru the threshold. You then say “It no longer is a *mere* guess; but there is no certainty yet.”

Do not, then, think of the threshold as a dividing *line*. It is a dividing *region*, just as the threshold of your bed chamber is not an abstract geometrical line, but a board of considerable width, enough to remain standing on.

The threshold, in a more abstract geometrical sense, has often been defined statistically by the numerical probability of an error being just one-half, that is, the probability of success being equal to that of failure. This by the way. You will not, in this demonstration, have to consider further this abstract threshold.

You will now demonstrate in the concrete what is meant by the threshold. You will make the human race apply itself to estimating weights. For convenience's sake you will here restrict yourself to that part of the human race made up of your partner and yourself. You need not hesitate thus to restrict your demonstration. You are not here expected to make a contribution to science by discovering the exact location of that threshold—that has been found out already with sufficient accuracy by others.

You will then here form a closer partnership than before with your partner. You will ask your partner to lift one after another the seven wooden weights, which look very much alike, and arrange them quickly (in fifteen or twenty seconds) in an orderly series from the heaviest to the lightest. Immediately your partner will

ask you to lift them in succession and make any change in their order that seems to you necessary. Then again your partner, and again you, and again your partner, and so on alternately, will do the same until you both reach an agreement.

Do not complain to the instructor that you can not reach an agreement, that the one of you regards a weight as heavier which the other regards as lighter. There are many situations in life where we absolutely have to agree. This is one. You should have selected a more congenial partner. It is now too late. You have to make the best of your choice. You have to compromise. How—that is your own business.

As soon as you both have settled the matter and the weights appear in what you both regard as the final arrangement, ask for a balance and weigh each weight in full grams, writing the numbers down in a single column in your note book, carefully preserving the order from the heavy to the light.

“In full grams” means “not using fractions.” Use the nearest integer. The “nearest,” not the next higher invariably nor the next lower either.

These seven numbers now form six ratios, the first and second number the first ratio, the second and third number the second ratio, and thus to the sixth ratio.

Now rewrite these ratios in terms differing by 1. This can easily be done by subtracting the “denominator” from the “numerator” and dividing by the difference thus found both the “numerator” and the “denominator.” For example, if you have 111 grams and 99 grams, the difference is 12. Dividing 111 by 12 and taking the “nearest” integer gives you 9 (because 111:12 is

$9\frac{3}{12}$. And dividing 99 by 12 gives you 8. So the ratio for this case is 9 : 8.

After having written in a column the six ratios in terms differing by 1, mark all those ratios with a cross which are wrong, that is, in which the smaller term precedes the larger term. Suppose you find then only one marked with a cross; record that ratio as surely being "within the region of the threshold."

Suppose you find two or more ratios marked with a cross; select the one that has the smallest terms. For example, if the "wrong" ratios are 21 : 22 and 53 : 54, record 21 : 22. It is clear—is it not?—that if you, the whole human race co-operating, already make a mistake in the case of the weight difference of one twenty-first, your estimation is already here becoming more or less guess work and will be still more so with a difference of one fifty-third. So you record, if you record any one ratio, rather that with the *smallest* terms differing by 1. The ratio with the smallest terms is the most interesting one from the practical point of view.

Thus you have made a concrete demonstration of the threshold of the human race in estimating weights that look alike. Never mind that your result is not very accurate. How to proceed in order to get a very accurate measurement, is a question which does not now and here confront you.

But suppose that none of the six ratios was wrong. Well—that was bad luck for you. You thereby learn that in psychology demonstrations it frequently happens that the "errors" are the *only* events that are interesting. Do not conclude that you are with your weights already beyond the threshold region, on the

side of certainty of judgment. Believe the author of this book when he tells you that you are not.

Of course, it does not follow that therefore you must *intentionally* now and then apply yourself in the *wrong* way. But it does follow that you must not by any kind of trick or jugglery (for example, by secretly weighing and marking the weights in advance) try to cheat the instructor. In such a case you do not cheat the instructor, but you *cheat yourself*. You then, having no errors, have to ask the instructor to give you a new set of seven weights, and you and your partner have to make the démonstration all over, until you have some error.

If, however, you have used no trick whatsoever, and nevertheless your ratios are all right, you simply have had *bad luck* (that often happens in this world) and you have to ask the instructor for a different set of weights and make the demonstration all over.

Second Part

The instructor will now give you two wooden weights considerably differing in size. You notice that these weights have holes on top. You will then fill one of them with scraps of lead until your partner and you admit that they are now as equal in weight as you can mutually agree on.

Remember that nobody has asked you to use any trick, for example, to close your eyes and balance these weights on the tip of your nose. You apply your body to these weights as naturally as you apply it to picking up a chair in one corner of the room and setting it down in another corner. Use only one hand always.

When you have filled one of the holes to the top, do not hesitate to put a little paper box on the top to receive more of the lead scraps. After making the weights equal, you weigh them on the balance in full grams and compute the ratio in terms differing by 1.

Now ask your partner the question: "Is this ratio (much or little) above or below the threshold which we found in the first part of this demonstration?"—Explain to your partner what is meant by "above" or "below" the threshold. "Above" means in this case that the ratio terms are smaller than those of the threshold. "Below" means that the terms are larger.

Further ask your partner what his experiences (before and after) were when, in the middle of a long journey made without changing the train, the locomotive was taken off and replaced by a much stronger acting engine. Then ask him whether he suspects that his muscle contractions applied to the one and to the other weight, might be comparable to those two locomotives, and whether his experiences might be comparable to those on that train before and after the change of locomotives. Could he have had similar experiences if instead of a change of locomotives something had happened to the train itself? What? Ask your partner to read what he finds on page 148 of his text on the kinesthetic sense. Ask him whether that helps him to talk about his experiences with the weights.

What happening to the train itself would be directly comparable to filling the holes with lead scraps? And what are (1) the experiences which would then be *equalized* on your railroad journey, and (2) those ex-

periences which are then *equalized* on your weight lifting enterprise? (Refer to page 148 of your text.)

Try whether you can avoid "changing the locomotives" by closing your partner's eyes and hanging each weight a little while from a string looped over his outstretched finger instead of permitting him to pick up the weight.

Finally read in your text all the references which you find in its index under "illusion" and tell what relation they have to the second part of this demonstration.

IV. *The Sound Localizing Reflex.*

You want to become familiar with the fact that your basic action equipment, received thru heredity, is your equipment with reflexes. Get then a concrete idea of the sound localizing reflex by finding out whether your partner's success in using sound localizing *habits* is conspicuously *improved* by the additional function of this *reflex*. Compare page 180 of your text.

Recall what you find on page 194 of your text about the dimension or dimensions of this reflex.

You are going to use telephone clicks. Will your partner be able to use the localizing habit described on page 194 of your text? The existence of what other localizing habits seems probable to you? For example, do you believe that you might possess a habit like this: Calling a rather strong click "front" instead of strong, calling a rather weak click "back" instead of weak, and a medium click "above"?

Remember during the whole demonstration that you want to discover if, in comparison with that success

which depends on his habits alone, the reflex improves your partner's success in localizing. Remember that the improvement can be demonstrated only by the percentages of errors, and that, if there are no errors at all, there will be no percentages to compare. Tell your partner, therefore, that you do not intend to prove that he is clever enough or unable to get thru without errors, that on the contrary the errors are the only valuable part of the demonstration. Tell him that you have, therefore, no objection to his reciting to himself, silently, anything he may wish to, while you are giving the clicks.

Ask the instructor to give you a printed record blank. On this blank you find 81 squares in nine rows and nine columns. The rows correspond to the nine stimuli Right, Right-Back, Right-Front, Back, Above, Front, Left-Front, Left-Back, and Left. Inform your partner that these will be the only stimuli ever given and that, therefore, he need not ever reply in any words but these. The judgment pronounced by your partner will be recorded by you by making a little cross in the proper column, but exactly in that square of the column which is located in the row corresponding to the stimulus given in that case. The question of "right or wrong" does not arise in this recording.

Remember, you never want to surprise your partner, but you prepare him by a "Ready" signal. Being sure that your partner's eyes are closed, you set the telephone, hit the key hard with your finger so that the noise of hitting serves as "Ready" signal, and two or three seconds later raise your finger. The break in the electric current causes the click in the telephone. Your partner pronounces his judgment, and you record it.

Continue this, irregularly varying the location of the telephone, until you have ten records in each of the nine rows,—a total of 90 judgments.

Never repeat the click, even tho your partner may tell you that he was not sure of its location. Recall to him that it is his very error, and not his being sure, that interests you.

Your partner will then ask for a second record blank and will make the same demonstration on you. You may, however, both of you, divide the whole task and alternate two or three times, being now subject, now demonstrator, now subject again, and so forth.

Now translate the records from your squares into the following summaries.

Lefts (L, LF, LB) regarded as Rights (R, RB, RF)....times.	} Total.....
Rights (R, RB, RF) regarded as Lefts (L, LF, LB)....times.	
Fronts (F, RF, LF) regarded as Backs (B, BB, LB) or Above...times.	} Total..
Backs (B, BB, LB) regarded as Fronts (F, RF, LF) or Above...times.	
Above called Fronts (F, RF, LF) or Backs (B, BB, LB)...times.	
Above called Rights (R, RB, RF) or Lefts (L, LB, LF)...times.	
Above judged correctly	times.

Then draw a final conclusion as to whether the reflex has shown its influence or not. Also state what your record shows, if anything, concerning the "habit question" raised above in the third paragraph of this chapter.

V. *The Reflex of Adjusting the Eyeball.*

You know that it has an effect on you, calling forth your bodily reactions, when the Other-One *turns his eyes on you*. In this respect we can speak of a local-

izing action performed by the Other-One with his eyes. But this is a *localizing habit* developed out of an *adjusting reflex*. Read pages 188-189 and 193-194 of your text.

The study of the sense organs as such is not necessarily a part of the psychologist's task. The *physiologist* must study *all* the sense organs. The *psychologist* studies them only in so far as *his definition* of psychology requires it. (Different psychologists differ in their definitions.) Read what you find about the definition of psychology in your text on pages 8-11, 405-408, 421, 422. Read also the reference you find in the index of your text to "higher senses". Do you see, then, any reason for familiarizing yourself with the adjusting reflexes of the organ of sight? What is the reason?

The reflex of *adjusting* the eyeball in its bearings is necessitated by the fact that the sensitive cells of the retina are very close together only in the central region. Things with small details (especially printed matter) can therefore act *properly* as stimuli only in that central region. That is the reason why the eyeball is constantly moving.

But it is a mistake to think that the stimulation is effective *during* the motion of the eyeball. Nature has made a provision whereby the excitation coming from the retina during eye motion is completely deflected (probably by the very nervous current causing the contraction of the eye muscles), so that there is virtually no reaction to the retinal excitation. (Understand what "deflection" means by using the index of your text.)

Think it over and answer the question whether the loss of this reaction during eye movement is a serious

one, or—possibly—even an advantage. What could your partner call a thing stimulating his retina during the eyeball's motion? Would that name be of any help to him or to you in getting along in this world? Remember, in answering these questions, that the eyeball is incapable of moving with a small angular velocity; that it always moves with a very great angular velocity.

Further ask yourself of what significance the loss of the reaction to retinal stimulation during eye movement is for the theories, rampant until twenty years ago, which explained the great beauty of a smooth curve in comparison with an irregularly bent zigzag or scrawl by the greater ease of following one of these lines *continuously* with the seeing eye. Why are these theories not found in recent books?

When your partner reads, he reacts only to the stimulations occurring while the eyeball *stops*. Demonstrate these stops by asking your partner to read—very slowly and aloud—from an easy text about twelve or fifteen consecutive lines. Close to his text on the right you place a mirror and watch your partner's right eye in this mirror. Let your partner rest his head against a support which will virtually exclude head movements. Make a pencil mark every time an eye movement occurs; but do not make a mark for the longer movement leading from the end of one line to the beginning of the next.

It has already been said that you must make your partner read aloud, in order that you may be sure that he is really reading,—and reading properly, that is, in the way *you want him* to read. Tell him to make

a *very conspicuous* pause at the end of each line, but to make *no conspicuous pauses* at the punctuation signs.

If the number of eye movements in a line is n , what is the number of stops? Write down in your note book the number of stops which occurred in each of the lines read. Also measure and write down the length of the lines. Why the latter? Also determine the average number of letters (and spaces) for each stop.

Now cover the right and the left side of a printed line with paper (fastening it with clips), leaving uncovered only as many letters (and spaces) as you just found by computation. Choose as the center of this group of letters a conspicuous narrow one, for example, a *t*. Then tell your partner to fixate with his eyes this central letter, and; *while keeping his eyes perfectly still*, to name all those letters which are clearly recognizable.

What significance does it have if he names all or not all of the letters exposed? Does it explain any facts which you are familiar with or have heard about in connection with the manner people read?

Do you know anything like it in human life outside of reading, even outside of the use of the sense of sight? Do you find anything like it mentioned on page 227 of your text? What is it?

VI. *Reversing One of the Visual Localizing Reflexes.*

You should first understand the purpose of this demonstration by reading pages 183 and 184 of your text. Ask the instructor to give you the card pictured on page 184 and a large total reflection prism,—large enough to look thru with both eyes at once. Mount the card on the table and the prism before your partner's

eyes so that the card, when your partner looks at it thru the prism, appears perfectly natural with the numbers from 1 to 16.

A similar procedure would consist in using a mirror instead of the prism. But that would have the enormous disadvantage of forcing your partner to "look" (at the object handled) in one direction, toward that mirror, and to "handle" the object seen in an entirely different direction, where it really is. You would then *not only* reverse your partner's localizing reflex in a single direction, *but* force him to acquire simultaneously a complexity of other very queer habits. Such a complexity would confuse you. As a matter of fact, a total reflection prism is nothing but a mirror, but it is a mirror which does not serve the purpose of looking at yourself, but of looking at other things *without breaking the line of sight angularly*.

Now give your partner the sixteen little squares well shuffled, not in any order. Wait till the hands on your watch have a convenient position and say "Start".

Do not accept your partner's work until the little squares have been distributed with sufficient accuracy so that each is properly placed, without conspicuously encroaching upon the area belonging to its neighbors. Then mark at once the time and reduce minutes and seconds all to seconds.

Now give your partner a chance to put you to the same task. After that he must distribute the little cards again, you again, and so forth. Stop this finally when you notice that the time of performing the whole work drops from the preceding case to this last only quite inconspicuously, or even rises slightly by accident.

Quite aside from having demonstrated the tenacity of the original reflex, you have again demonstrated the possibility of breaking up a reflex, substituting for the original muscular action a different muscular action. And you have again the material for the construction of the learning curve. Show your partner's learning in a graph similar to the one you made in the second demonstration and follow again the instruction given in the last paragraph of the second demonstration.

VII. *Some Habits of Rhythm.*

This demonstration has to be continued for at least two months, altho it takes only a few minutes each week. It must therefore not be begun too late in the course.

Your partner may have "rhythm". If you ask him and he answers in the affirmative, ask him further "what rhythms?" he has. If he does not understand your question, read to him page 338 of your text. It is not very probable that he will assert that he already possesses the 5-stroke or the 7-stroke rhythm. Therefore you will do best to choose for your demonstration of the acquisition of rhythm habits, the 5-stroke and the 7-stroke rhythms. Make an agreement with your partner settling the question which of you shall learn the 5-stroke rhythm and which the 7-stroke rhythm.

In order to be able to demonstrate *in the end* that your partner has acquired a (weaker or stronger) rhythm habit, you must measure *how well* he can perform a certain act, which later will depend on the aid of that rhythm habit, at the present time without that rhythm habit. You will then later also measure how well he can perform that same act (which he will not

practice meanwhile), and the difference will tell you whether he has acquired, weakly or strongly, that rhythm habit.

Suppose your partner has chosen to be trained in the 7-stroke rhythm. You then give him the following initial test.

You make him stand before a large wheel (the wheel placed at your disposal is of three feet diameter) with its axle in a horizontal position perpendicular to his line of regard. He looks at the circumference of the wheel and sees there large digits appearing from above and passing away below. You notice that only the digits 1, 2, 3, 4, 5, 6, 8, 9 are used and that they appear at random, without any order whatsoever. The reason why 0 and 7 are omitted is this. You will later ask your partner to read the digits aloud as they appear, and to pronounce them very pointedly. This can be done only with monosyllabic words; and therefore the bisyllabic digits are left out.

Before the wheel you place a screen with a window so that most of the wheel is never visible, and that never more than two digits are simultaneously visible thru the window.

Now you adjust the speed of the electric motor which drives the wheel. You increase the speed of the wheel while your partner is reading off each digit at the moment when it disappears behind the bottom frame of the window. As soon as you have reached (be a little patient in doing this!) such a speed that your partner begins to find it *impossible* to read off *each* digit correctly, you decrease the speed again a little. Thus you have

found the greatest speed at which your partner can read off these digits pointedly without making any errors.

Now you are ready for the real test. Before your partner, between him and the wheel, you put a solid little table or wooden stand, just high enough for him, while he is standing, to place his hand on conveniently. You then give him a short-handled and rather heavy rubber hammer to hold in his hand, and tell him to hit the table with the hammer on reading off every *seventh* digit without letting this hammer work in any way interfere with the manner or the correctness of reading off the digits. Seat yourself a little sidewise and to the rear where your partner *can not see* you or your motions distinctly. Count *silently so that he can not hear* you from 1 to 7, beginning with each one of his hammer strokes. In both your hands you hold little automatic registering machines, so-called tallying registers. Whenever he hits correctly after you have said to yourself "7", you press the button in your *right* hand. Whenever he makes an error, not hitting at the right moment or doing it at a wrong moment, you press the button in your *left* hand, and at the time of his hitting begin with "1" a new silent counting.

Continue this test for five minutes. In order to do that conveniently, you start, at the moment when your partner begins his hammer and reading work, an interval timer set to ring after five minutes.

During the test, while your chief attention must be paid to pressing correctly the buttons in your hands, you must give enough secondary attention to your partner's reading to help him to be aware of it if he should fall into reading slovenly, leaving out digits which ac-

tually appear, or reading the digits wrongly. Discount a merely occasional lapse of speech such as—maybe—pronouncing *sie* instead of *six* or *fro* instead of *four*. But do not permit real and serious errors in reading, for your whole test is based on the presumption that your partner reads off the digits correctly. “Errors” are permitted and valuable in this demonstration *only* in so far as the rubber hammer may strike at the wrong digit.

At the end of the five minutes look at your tallying registers and record carefully the numbers they tell you for correct strokes and errors. Also ask your partner (and write down) whether he considers this hammer and reading work easy or difficult to perform correctly. You would better ask him this question *before* you have told him the numbers which you have found on your tallying registers.

Your partner will now test you in the same manner, with this difference only, that he will tell you to hit the table with the hammer on reading off every *fifth* digit.

These tests now will not be repeated for at least two months. Meanwhile you will both regularly five minutes (neither less nor more) per week take an exercise training you in the rhythm habit which you have chosen. It is essential that this exercise be taken faithfully. Begin today.

Your partner, training for the 7-stroke rhythm, will proceed as follows. He will stand before the frame described on page 347 of your text. He will take the rubber mallet in his right hand (we suppose him to be right-sided,—if his left side is his better side, all rights and lefts must be exchanged) and hit the button on the left. He carries out the rebound and makes a preparatory

movement for doing the same thing toward the right button. After the next preparatory movement, for the left button, however, he "changes his mind" by adding a further preparatory movement leading his hand thru a short curve (a quadrant) to a place a little above the center of the frame. This finishes the whole group of seven motions. There is no counting of any kind necessary in this performance, either by your partner or by you.

After the horizontal performance your partner now does the same in the vertical direction. The final curve leaves his hand a little to the right of the center of the frame. He goes again thru the horizontal performance, again thru the vertical performance, and so on, until you tell him that his five minutes are over. Watch his motions while he exercises, and if he does not do the work right, correct him. You are responsible for his learning to do the work right. See to it that he does *not make any pauses* between his motions, especially not after the quadrant, *or extend or reduce the time* for any of the seven motions so that it becomes very different from the duration of any of the other six. Each of the seven motions should with fair approximation be of the same duration. But no exactness of equality of the duration is desirable. Let him work naturally. By fair approximation to the same duration is meant only that none of the seven motions must ever last even approximately *twice* as long as any of the other six.

After your partner has finished his five minute exercise, he makes you take your five minute exercise. You go thru the performance consisting of five group motions, which is described on page 347 of your text. Both

you and your partner take your five minute exercises regularly once a week for at least two months. Then you are ready for the final test.

In the final test you proceed as in the initial test. You put your partner before the wheel and make him read aloud the digits and hit the table with the hammer on reading off every *seventh* digit, for five minutes.

Compare the numbers given by the tallying registers in your hands with the numbers obtained in the initial test. The difference is an indicator of the strength of the rhythm habit which your partner may have acquired during the exercises of the last two months. Also ask your partner how easy or difficult he considers the combination of his hammer and reading work now.

VIII. *The Accommodation Reflex Used for a Purpose Other than Adjustment of the Eye.*

Read what you find on pages 189 and 190 of your text on the reflex which flattens the lens, and on page 244 on the use of the accommodating apparatus for the purpose of "localizing in more or less depth" (by habit or by reflex).

For this demonstration you use an apparatus designed by Hering (of whom you have heard in connection with color vision). It is essentially a box-like frame which has a small object (for example, a bead) suspended as a mark at about the middle distance from front to back. Your partner looks thru a horizontal slot steadily at this mark. The slot is so arranged (for example, by duplicating it, one behind the other) that your partner can see neither the floor nor the ceiling of the "box", but easily a little space above and below the mark.

You insist on your partner keeping one eye securely covered and out of function.

Now you give a "Ready" signal and two or three seconds later drop a bead or other object similar to the suspended one. There are four holes in the roof of the box, two in front, two in the rear of the mark, which you must use at random for dropping. These holes are arranged so that, no matter which of them you use, the object dropped will appear to your partner at about the same distance sidewise from the mark. You ask your partner whether it was farther or nearer from him than the mark. According to his answer you write in your note book, in a column, case after case, either F or N and add to it a cross if the answer was wrong, a ring if the answer was right.

It is advisable to vary a little the size of the objects dropped. Why?

Never repeat a case on account of being told by your partner that he does not feel sure. Call his attention to the fact that you are not trying to find out how clever he is, and that he ought to have found out by this time that the errors recorded in psychology demonstrations are often the only really valuable part of the procedure.

When you have twenty-five cases, stop. Take a rest by letting your partner work with you in the same manner.

Then proceed again with your partner as you did at first, but with this difference that now you do *not drop* the object, but *lower it slowly* on a fine black thread, making sure that you go below the level of the mark and that you expose the object to your partner's eye (one

eye) between two and three seconds. Finally your partner does the same with you.

Now compare the number of errors you got in dropping and in lowering. How do you explain the difference?

After this both you and your partner make another series of twenty-five drops (remember "drops only") each, but this time with both eyes open. How many errors do you find now? Do you think that the facts found warrant the belief that another adjustment, mentioned on page 244 and also on page 188 of your text, plays a role here? Do not answer rashly!

If this adjustment (the angle of convergence) is followed by an action of "localizing in more or less depth," what is the *direct stimulus* of this action of localizing in depth? Look to pages 148 and 149 of your text for a suggestion.

Can the sensory-motor function hinted at in the last two paragraphs be the explanation of the facts which you observed in dropping things before your partner while he had both eyes open? If so, why so? If not, why not?

Could the habit of "localizing in depth" described on page 258 be the explanation of the facts discovered by dropping things before your partner while he had both eyes open? If so, why so? If not, why not?

IX. *A Species of Motor Condensation in the Nervous Functioning.*

First examine your partner and, if necessary, teach him all that is said on pages 220-222 of your text. You find it said there that "special conditions delay the re-

action'' to each of two reflex responses; and finally neither of them occurs, but instead of them the pronunciation of a certain word. This ''delay'' might make you feel inclined to become shaky in your conviction that ''states of consciousness are not to be regarded as causes in science.'' A friend believing otherwise might urge you to admit that ''the delay is caused by your partner's *thinking* and that that thinking then becomes the real cause of his later pronouncing that word.'' We shall help you here to defend your position.

It is really only a figure of speech when we say an action is delayed. A reaction cannot be delayed, for the nervous system is not — — — — (look up in the index of your text the items ''afferent and efferent'' and find in the text the words with which to fill in this blank), but a system of conductors. No stream of excitation can enter the system without a like stream passing out during the time. The ''delayed reaction'' only means, really, that *you cannot notice* any reaction of which you are sure that it belongs to that stimulation. This means that the muscular reaction is so widely scattered that it simply becomes a part of what the physiologists call ''the general muscle tonus''.

''But why is it thus scattered? Why does the nervous current, instead of going mainly to the (reflex) motor point corresponding, go in the main to innumerable scattered motor points?'', asks your friend. The answer is simple enough: Because some preoccupation (compare the pages from 91 to 97 of your text) has been established which opens up the paths thus scattering the current. Such a preoccupation can easily be established, for example, in accordance with our speech habits, by

somebody saying authoritatively "No, no,—don't, don't;" or by your instruction given previously to your partner to the effect that you care nothing about the direct localizing reflex movement. The current will then go, in the main, to the higher center serving the reproduction of the words of instruction and thence to the muscle systems pronouncing these words or to the general muscular system, in the latter case merely adding imperceptibly to the general muscle tonus.

But these muscle contractions, belonging to the speech functions or to the general muscle tonus, are themselves of the nature of (kinesthetic) stimuli (compare what you find on pages 361 and 362 of your text) insuring a continuation of the streaming of excitation thru the nervous system, again resulting in either the pronunciation of such words or an addition to the general muscle tonus. And this streaming of excitation more or less scattered thruout the nervous system may go on for seconds or minutes (or even hours) without bringing about any muscle action which you would regard as worthy of being called "the" reaction to the initial stimulus.

Gradually, however, a change may come about in the streaming within the nervous system. It may be that from the beginning the intensity of the flux was a trifle stronger in a certain motor direction than in all others. By the law of deflection, (compare pages 102 to 106 of your text) then, the flux in that direction must become stronger and stronger and very strong, if you only give it time enough. Or a second stimulus occurs and establishes a current in a certain direction (by reflex or habit) which now gradually draws the other currents into it-

self. Thus, finally, a definite action occurs which seems to have such a clear logical relation to the initial stimulus, that everybody calls it "its reaction", merely adding that "it was delayed."

The delayed reaction thus is in no way mysterious, for the simple reason that it is not in reality a delayed reaction. It is mysterious only to those who think of a nervous process as if it were like a ball ("one" ball, "the impulse") running along a bowling alley, perhaps striking the walls here and there and very soon reaching the ten-pins. But if there should be an elevated ridge made of inclined planes and crossing the alley, the ball may run up and stay on the ridge a long time in delicate equilibrium. A little later another ball may get lodged on the ridge, and another and another. But after a considerable time (delay) a naughty boy ("the will") who has no respect for the laws of "mere matter" comes and kicks one of those balls against the others with the result that they all run off the inclined plane and toward the ten-pins. This antiquated conception of the brain as a tank (or, here, ridge) where things (knowledge) may be stored for a long time until a mysterious force drains the tank, is still rather popular. But modern biological thought is in the direction of regarding the nervous system as what we called it, a system of conductors and nothing else.

Returning now to what you want to demonstrate, you are going to touch your partner with two compass points, having previously instructed him to respond with a single reaction, either that of saying "one" or that of saying "two". You are thus going to demonstrate that species of motor condensation of the nervous func-

tioning which is the most common species of motor condensation,—so-called space perception. Ask your partner whether he understands clearly what your text means by sensory condensation and motor condensation. Make it still clearer to him by referring to the figures and the descriptive words on pages 224 and 225.

Then draw in your note book nine vertical lines, leaving between them eight blank columns. The first, third, fifth and seventh of these columns you fill in with the consecutive numbers from 1 to at least 20. You will soon find out how far you will have to go beyond 20. These numbers really stand for one-sixteenth, two-sixteenths, and so forth, of an inch.

You now have the choice between two methods. You may proceed thru the column in regular order and first touch your partner with two compass points 1 sixteenth of an inch apart, then with two points of 2 units interval, then of 3 units interval, and so forth. But in that case you have to touch him now and then, very irregularly, with one point only; and if he should say "two" even in such a case, you have to tell him that he has spoiled the whole procedure and that everything (the whole column) has to be done over again from the beginning, your record thus far obtained being destined for the waste basket.

If you and your partner do not like that, you have to choose the second method, in which the distances written in the column are used in quite irregular order. But let us suppose you succeed in training your partner never to say "two" when there is the least doubt about there being two. You can then use, and we assume now that you are going to use, the first method.

You already know about the necessity of a "Ready" signal before giving the stimulation. When applying the points, remember that you must not apply them in the manner in which a bird pecks at a grain. You must place the two points on the skin *with equal pressure for about two seconds*, certainly not less than $1\frac{1}{2}$ seconds. You must place them firmly, so that you see the skin indented; but not with so much pressure that your partner's skin will show the marks even half a minute after removal of the points. Treat your partner as you would like to be treated yourself.

Choose a region on the inner surface of your partner's arm near the wrist. Choose a smooth, fleshy region, not one underlaid with tendons. During the first two series of applying the compass points apply them so that a line drawn thru them would be parallel to the axis of the arm. During the third and fourth series apply the points crosswise.

During the first and third series pass from the smallest to greater intervals, during the second and fourth series from greater to smaller intervals. Do not stop the first series until you have had at least eight consecutive "two" judgments pronounced by your partner (eight not intermingled with "one" judgments). Write in the proper blank column to the right of each stimulus the judgment "one" or "two."

You now notice—most probably—in each of these four columns a middle region in which appear both the judgments "one" and "two" mingled. Write at the bottom of each column that distance of the compass points which corresponds to the middle of this threshold region. Then take the middle between these two locations

in the first two columns and also the middle between these two locations in the last two columns. These two values enable you to compare very quickly the threshold lengthwise with the threshold crosswise. Did you succeed in demonstrating what your text says about this matter on pages 221 and 222?

X. *Calling Things Large.*

Place on the table before your partner a large sheet of paper and on it a little scrap of dark colored (perhaps green) paper, round, square, or of any irregular shape, and of about two inches diameter. Tell him to look steadily at one of the corners or at any other marked point of the paper scrap until you have counted 200. It is important that he hold his eyes as still as possible during that period. Immediately after counting 200 you tell your partner to look steadily at a point on the floor and to say "I see it" as soon as he sees something of the same shape as the paper scrap appearing like a ghost on the floor. At once you make him look, for the same purpose, at a point on the nearest wall of the laboratory room; and after that on the ceiling; and after that on the farthest wall of the room. And then you may hold a uniformly colored book cover about six or eight inches before your partner's eyes and tell him to see the "ghost" there.

If the "after-image" (this is the technical name for such a ghost; compare page 290 of your text) did not last long enough, give your partner a few minutes rest, and then repeat the whole procedure, trying to make him look at the several places in quicker succession,—

maybe also after counting a little more slowly and strengthening the after-image by lengthening the time of exposure.

Now ask him *how big* he would call the ghost seen on the book cover, the floor, the nearer wall, the ceiling, the farther wall. Tell him, if he talks of its color, that you care nothing about its color, but that you are interested solely in its varying size.

Ask your partner whether he thinks that there is any reason for believing that the number of sensitive cells which are in a state of excitation has anything to do with calling a thing large or small or larger or smaller.

No matter whether he answers this last question in the affirmative or in the negative,—ask him, further, if he thinks that the Other-One could be misled into calling a small thing large or a large thing small by *keeping from him* the most, or the more, *impressive* information concerning the distance which the thing actually is from his forehead.

For example, if you want to induce the Other-One to accept a dime in exchange for a dollar's worth of groceries, would you be likely to succeed if you *thrust* your hand, holding the dime, *forward toward his eyes* until they are within a few inches of touching him?

Or if you want to induce the Other-One to talk of your brother, three hundred feet away, as “being like an ant”, would you be likely to succeed if you put your brother three hundred feet away on a busy street where there are *plenty of people seen in the space between?*

Or if you want to induce the Other-One to talk of your brother, three hundred feet away, as “being like

an ant'', would you be more likely to succeed if you stand with him on the roof of a sky-scraper, looking over the railing, having put your brother three hundred feet below on the street, *with nothing visible in the space between?*

If there were men everywhere floating in the air in the space between, there would be some *impressive* information concerning your brother's distance. Do you think the Other-One would still talk of him as "being like an ant"?

Now let your partner formulate the rule by which "information" (right or wrong, but) impressive and believed about the distance, influences the Other-One in calling things large or small (quite independent of the excited area on the retina).

Was there any reason for thinking that this information (right or wrong, but) impressive and believed about the distance, *was impressive* when your partner projected the after-image on the book cover, the wall, and so forth?

Now ask your partner how he would answer the following question: "What are the two factors on both of which the Other-One's habit of calling things large (larger, smaller, and so forth) depends, provided that both factors exist?" Tell him that both these factors are already hinted at in the preceding pages: one in the paragraph beginning with "Now let your", the other in the paragraph beginning with "Ask your partner". Which of these two factors constitutes a simpler and which a more complex habit?

What relation has this demonstration to what is discussed on page 224 of your text with reference to figure

B? Apply that figure to each of the two factors just hinted at.

What relation has this demonstration to what is discussed on page 226 of your text in the paragraph beginning with "Space"?

What is the only difference between this demonstration which you made on your partner and that experience with the Other-One which is described on the lower half of page 242 of your text? What is the *only* difference in the manner of stimulation described there and that used in this demonstration? (How long did you wait between seeing the moon at the horizon and at the zenith?)

What is said on page 243 of your text about reversing the substitution of one action for another action? How is this related to the figure on page 124 of your text?

Be sure to remember what you have learned in this demonstration in order to make use of it in demonstration XI, and also in demonstration XIV where "size" concerns us in connection with pseudoscopy.

XI. *Wasted Habits of Estimating Space.*

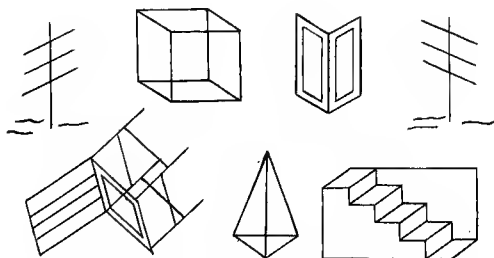
What is that name which is used in your text for both wasted reflexes and wasted habits? Use the index in order to give the answer.

What does your text say about the habit of overestimating or underestimating angles? Look in the index under angles.

If we call the habit of calling an angle by such a name as "large" or "small" or "nearly 90 degrees" a *substituted* action, what does that action which is in this

case replaced by this substitute consist in? Does not the replaced action consist in calling the thing flat? Look at the thing on page 238:

What do we mean when we call a thing (any of the things in the accompanying figure) "viewed perspective-ly"? "Per" literally means "thru"; and "spect" literally means "seen." What has this meaning of "per" to do with the preceding paragraph?



Make in your note book carefully an enlarged drawing of any one of the things pictured in the figure here and tell your partner to "look thru" that thing. If you have not yet agreed with your partner as to what is meant by the command to look "thru" a picture, return to the last paragraph and reach an agreement. Mark the end points of a *properly chosen* line in your drawing *a* and *b* and tell your partner to *follow this line* in looking "thru" the thing.

If your partner possesses some perspicacity, he will at once ask you: "Must I look at *a* first and at *b* later or at *b* first and at *a* later?" Choose one of these two points and tell your partner to *arrest his eyes* on it and not to continue looking thru the thing until you give

your permission. Then count silently to 15 and suddenly, instead of giving him permission now to look thru the thing, cover your drawing with a piece of paper. At once ask your partner to show you, using pencils or matches for this demonstration, how the line was (or, perhaps, the lines were) situated in the space thru which he had hoped to obtain your permission to look. Write down in your note book a description of the situation of that pencil or that match (or, if two or more lines, those pencils or those matches) in some such manner as is indicated by this example, "Pencil going away from me into depth, slanting a little to the right and downward," using whenever necessary other terms, perhaps even opposite to those in this sample description.

Now repeat everything spoken of in the last paragraph, with this difference, however, that you now choose the other point as the one on which your partner has to *arrest his eyes* before being permitted (which he actually is not) to follow the line in looking "thru" the thing.

You may have to repeat both cases many times before you derive the conclusion that a certain habit of naming (describing) prevails in the one case and another certain habit in the other. While you are investigating what is the prevailing habit in each case, you really make a *statistical* investigation in the one case and in the other case. A *single* observation is *insufficient* because habit functions (especially human habit functions) are very much subject to accidental influences (unknown and uncontrollable by you).

Now you will have to answer two questions which will inform you whether you have really profited from

this demonstration and from your study of the text or not as yet. These two critical questions are here directly following.

If you should hear anybody call one of your two cases a "perception" and the other case an "illusion", how could you defend him and justify his talk?

If you should hear anybody call both of your cases "illusions", how could you defend him and justify his talk?

If you have told your instructor what your answers are and feel quite sure now what it is what your text calls an illusion, proceed with your partner in an entirely novel way. Tell your partner to arrest his eyes as long as he wants to on that end point of the line which you have chosen for the start, then to follow the line and to arrest his eyes on the other point again as long as he wants to. Let him demonstrate now with pencils the location of the lines. Does this case agree with the first above? Or with the second above? Or is it different from both? Perhaps a kind of combination of both? Combined in what manner? Are both points nearer than each other or does time play any role in the judgment?

Try then still another procedure. Tell your partner to proceed from the starting point and to follow the line in looking thru that thing, but to be sure not to arrest his eyes even for the slightest moment at the point which you have not chosen for the start. Tell him to be sure to slide over the end point into any direction of space. Ask him to demonstrate how the line is then situated in space. Does this case agree with the first? Or with the second? Or is it different from both? Whatever it may

be, why is it so? That is, in the formation (long ago) of this habit, what action was substituted for what?

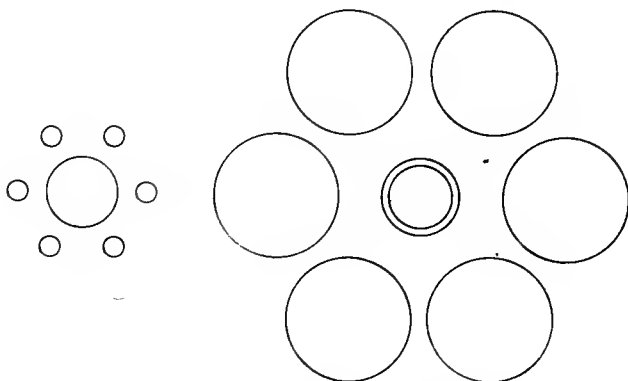
What general statement would you make, then, concerning the question: What is the nature of the class of stimulation which in these demonstrations called forth either the response of saying "This point is the nearer one of the two" or instead of this response the equivalent response of demonstrating with the aid of a pencil the situation in space of a line contained in the picture? "*The point not favored by the adjustment of the eye is generally called nearer*"—would that statement be the answer?

You have thus far worked with only one of many drawings any one of which you could have used for the same demonstration and of which you see only seven representatives in your figure. Make in your note book now an enlarged drawing of each of the other six and demonstrate your partner's habits on each one of them in the same manner of procedure just used. Tell in your report why the habits illustrated by all these seven drawings are often—and justly—called (1) illusions of (2) reversible (3) perspective.

After having used all the pictures of the last figure, now show your partner the next figure, which looks like two solar systems. Ask him the following question: "If you were asked to cut out with a pair of scissors the centers of the two solar systems pictured here (that is, the two *suns*) in order to use these two suns as pictures for the decoration of the walls of your room, and if you had been asked to *match* these two pictures of only the central suns as well as possible, which of the two con-

centric circles seen in the right system would you prefer as a match for that cut out from the left system?"

Your partner's answer is undoubtedly the result either of his reflexes or of his habits. Was his answer determined by the first or the second or both of these two habits enumerated below?



(1) Substituting for the phrase "*this* is small and *that* is still smaller" the new phrase "*that* thing might be too small to be a match." Do you think he has this habit? You might find out by skilful questioning whether such substitutions exist in his nervous system. Try to find out. Skilful questioning for the purpose of discovering what a person's hidden habits are, is nowadays, by many who use it professionally, called technically "psychanalysis." You can psychanalyze your partner, if you just try hard enough. The fact that many of your partner's habits are *hidden* from you (maybe hidden from him, too), does *not* indicate that they are *weak* habits. However, you may perhaps feel

confident as to whether he has this habit or not, without even psychanalyzing him.

(2) Substituting for the nomenclature "large system—small system" the nomenclature "near system—far system" (compare in your text on page 241 what is said of figure A) and then again substituting for this latter reaction the pronunciation of "small and large sun." Has this last habit been discussed or hinted at in any previous demonstration in this manual? Do you think your partner has this habit?

What then is your final answer to the question: Was your partner's choice determined by the habit (1) or by the habit (2) or by both?

In the case (2) just referred to, was there again "perspective"? If so, answer the question: What thing was here the *start* and what thing was the *end* of the movement of looking thru?

Now turn to the third of the figures of this demonstration and show your partner the three pictures of which it consists. In one of them he sees on one side a

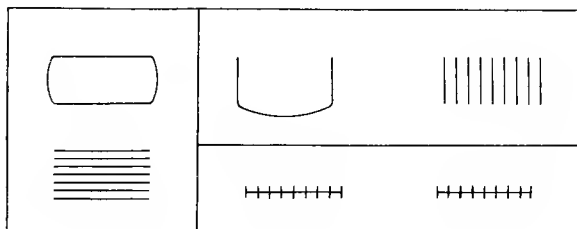


figure which looks like the cross-section of an old-fashioned iron kettle, on the other side something re-

sembling a palisade. Ask your partner whether he thinks that after cutting out with a pair of scissors the exact kettle he could or could not cover the palisade. Would a piece of the latter picture remain uncovered by the kettle? Or, if he tried to cover the kettle, would a piece of it remain uncovered by the picture of the palisade?

Ask him the same questions with respect to the picture of which one side looks somewhat like the cross-section of a thick cushion and the other side like steps leading up to a building.

Ask him again the same questions with respect to the third picture of the figure, where you have on both sides something looking like a fence and between the two fences a piece of unfenced "landscape." Ask him in this case whether he thinks that by cutting out the horizontal strip of one of the fence pictures he could or could not exactly cover, or would cover more than, that strip between them picturing a "vacant landscape."

Has "perspective" anything to do with these "wasted reactions"? (By the way, what reactions of your partner are here wasted?) Does your partner look "thru" that cushion? Does your partner look "thru" that flight of stairs? Does your partner look "thru" that kettle? Does he look "thru" that palisade? Does he look "thru" that piece of fence? Does he look "thru" that vacant landscape? In every case in which he really looks "thru" something definite, he must tell you what the start and the goal were between which the "thru" movement occurred. Perhaps there was less looking "thru" in some of these pictured things than in others. Does that make your partner's illusions plausible?

(Remember that looking "thru" means favoritism to some point in a certain eye-adjustment. Compare p. 49.)

A very different way of explaining these illusions is the old-fashioned one of some who have said that the six kinds of things shown in the last figure should be put in two classes: (1) Areas which show subdivisions and (2) areas which show no subdivisions. They have further said that it is worth while to remember the "law" that a subdivided area always looks longer than one that is not subdivided.

Let us warn you against that "law". It is not worthy of such a name. Trying to apply that specious law you might ask your tailor to subdivide your suit lengthwise by designing it with many lines running across it, horizontally, as in that flight of stairs. If you hoped that that would make you appear taller to other people, you would be disappointed. Why? Because the length of your body does not offer to the spectator any "perspective," and nothing depending on "perspective" could thus become actual in the habit functions of your friends looking you over.

On the contrary, your friends, instead of calling you tall, might call you stout because the horizontal lines would be likely to induce them to give your width that very measurement which you are not anxious to have applied to you, which indeed you are avoiding. As in vesture so in architecture subdivisions made by long lines do not call forth any exaggerated judgments of the space crosswise to these lines, but rather of the space along the lines. In Gothic architecture, for example, the prevalence of the vertical lines is intended to—and does—impress the spectator with the direction leading to

heaven. And in classic architecture the long horizontal lines tend to call forth the judgment of "broad" and firmly resting on the earth rather than that of "tall". Beware, therefore, of applications of this specious law to dressmaking or to architecture.

XII. *Natural and Artificial Blind-Spots.*

Anatomy tells you that the spot on the nasal side of your partner's retina where the optical nerve enters is not supplied with sensory cells. Use the index of your text and find out what your text tells you about the possibility of reacting by means of the localizing reflex to a stimulating object which sends its light rays exactly to that spot.

How would you proceed in order to demonstrate the blind spot in your partner's eye? You might take an old newspaper and paste somewhere on the printed matter a round bit of white paper of about one inch diameter. Then make a conspicuous fixation mark (a cross made with a black or colored pencil, for example) about five inches to one side of that piece of white paper. You may ask the instructor for some cards already prepared in the manner just mentioned.

Are you going to permit your partner to keep both eyes open? If not, why not? If you are going to use his right eye on the fixation mark, should the white paper be pasted on the right or on the left side from the fixation mark? In order to answer the last question correctly, recall that the optic nerve does not enter the eyeball in its "pole" (where the fovea of the retina is located), but a little *toward the nose* in either eye.

Now make your partner keep his eye steadily on the fixation mark while he moves that newspaper or prepared card toward and away from his face until he has found the distance at which he can truthfully exclaim that the white paper pasted on the figured background has entirely disappeared. From that moment on he must keep eye and newspaper or card perfectly still in order to answer your question whether he is willing to say that instead of the white paper there is now a hole in the figured background or what else he is willing to call it. Most likely what he now tells you about that spot itself will in no way differ from what he tells you about the surroundings of the spot. Try a checker board and other figures on your partner for the same purpose.

There are, however, exceptions to what was said at the end of the last paragraph. For example, if you use two circles slightly overlapping, and have just the overlapping parts extinguished by the blind-spot, it is doubtful whether your partner will describe the whole thing as two complete circles. Try him out. If he, on request to indicate what there is before him, draws two incomplete circles, there is only one explanation of this. It must be a stronger habit. He must be more familiar with things resembling two incomplete circles than with "two rings slightly overlapping". Try to psychanalyze him and thus to discover what his hidden habits are. Try to find out whether he handles this or that or another kind of things more frequently. Suggest to him, in addition to pairs of things, such things as link sausages, bales of cotton or hay, parcels or sacks stuffed with soft material and tied tightly with a string, and

so forth. Maybe you will discover why this case with the blind-spot was seemingly an exceptional one and after all is not exceptional.

Now you can try out your partner's habits of using, instead of his natural, an artificial blind-spot. An artificial blind-spot can easily be produced; it does not require any drug application or surgical operation. Just tell your partner to hold one of his fingers *horizontally* before one of his eyes about six inches from his face, while he closes the other eye. Make him look thru the window at the sky; or make him look at a large ground glass window pane. After a little while ask him if his finger is not beginning to appear as if it wanted to become transparent. But be sure to warn him against becoming too interested in his finger; he must be much more interested in the sky or the ground glass than in that finger. If he answers your last question in the affirmative, tell him to hold a pencil at almost arm's length so that it crosses the finger and ask him if he can see the pencil thru the finger. You will get a very surprising answer. However, if you think it over, you will recognize that the finger created "an artificial blind-spot". And your partner's answer was dependent on his habits. Give an example of such a habit chosen from those which you observed with the natural blind-spot.

However, without knowing what you were doing, you have actually done something to your partner that you should never do in psychology demonstrations. You have played a trick on him. You did it in the following manner.

When you told your partner to close one eye, he

probably closed the lid with his lid muscles. Now, it is virtually impossible thus to close one eye entirely without closing the other eye at least partially. In all probability your partner closed the upper lid of the open eye so much that it obstructed considerably the pupil, that is, the optical opening of the eyeball. And even the lower lid probably obstructed the pupil. This obstruction has an optical effect which physicists call "dispersion" of the light. For simplicity's sake let us in the following speak of black (which is really lack of light) as if it were a special kind of light. In all the reasoning that concerns us here it amounts to the same.

Since the dispersion occurs mainly on the edge of the upper lid, much light is thrown from the bright background above over the dark finger region. And some (more or less) light is also thrown from the bright background below over the dark finger region. Ask your partner if he does not observe that quite clearly as soon as he brings his eyelids a little more closely together. But when he holds his pencil *vertically* (crossing the *horizontal* finger) behind the finger, instead of light "the black", a dark streak, from the upper piece and the lower piece of the pencil is now thrown across the broken space between the two pencil parts. And it is then, no matter what your partner's habits, unavoidable that he should tell you that he sees the dark pencil unbroken "thru" the much lighter, translucent, so to speak, finger region. He simply sees there the dispersion of the black appearing pencil.

You can make the existence of the fact just mentioned—this trick played on your partner—still more obvious

by asking him to slant the pencil 20 or 30 degrees. At once your partner will tell you that that pencil piece which is seen "thru" the finger has broken into two parts, both being, not slanting, as the pencil, but vertical, the upper one *falling* from the place where the upper pencil touches the finger region, the lower one *rising* from the place where the lower pencil touches the finger region. And the falling one of these two vertical streaks is probably more conspicuous because the dispersion of the black appearing pencil is probably more powerful on the edge of the upper, more obstructing, lid than on the edge of the lower lid.

In order to avoid this trick you have to insist that your partner keep his seeing eye *wide* open, the lids as widely separated as possible. Obstruct, then, the not seeing eye, whose lids will also be widely separated, by tying a thick black cloth loosely over it. Now let him put his finger again before the seeing eye, against the same bright background. Let him hold his finger in any position, perhaps, for a change, in a vertical position. Let him look steadily until, again, the finger begins to become translucent, as it were. This will not occur so readily when you do not use that trick, and you must have more patience with your partner now than before. But when it occurs, let him again place his pencil across at the same distance behind the finger, move it slowly up and down, change the angle of slant, remove the pencil altogether, replace it again, and so forth, but holding his finger and his eye as still as possible during all this time.

Notice if your partner's actions, describing what he sees, do not reveal habits quite similar to those which

function with the blind-spot. If that is so, you are entitled to speak of an artificially created blind-spot in this case.

Try now still another method. Take a red disk of about three inches diameter, put it on a white disk of about five inches diameter, (the actual dimensions matter little) and spin the set on the color wheel. Tell your partner to look at the color wheel steadily, best keeping his eye fixed on the center. After a minute or more ask him if the whole disk does not look as if a veil, partly more, partly less dense, had been drawn over it; and if the white ring, more particularly, does not appear as if it were a translucent veil thru which a colored background could be noticed. Without spinning the double disk he would probably deny it because his habits are not such that he would very readily apply to a white paper disk like the one employed the name of a veil, cloud, or something similarly translucent, while the disk was standing still and this or that dot, dent, or other special feature of it could be clearly noticed. But when the disk is spinning you may find him willing to do that.

Ask your partner of what color the background is which seems to shine thru the "veil". How do you explain his answer? What must be his habits? How is this case related to the preceding two cases? That is, if you speak, here too, of an artificially created "blind-spot", what is the shape of this artificial blind-spot in comparison with the shape of the other blind-spots?

Popular language in all these cases of blind-spots would say that the blind-spot "is filled in by the imagination". Compare, by utilizing the index, what you

find about imagination in your text. More exact—scientific—language says in the case of a blind-spot merely that when your partner's action was observed by you, "not everything" which *seemed* to be reacted to, "really existed" or "need really have existed" as a stimulus. Thus you may say that you have here examples of actions *more complex than the stimulation seemed to warrant*. Has this last statement any logical relation to the explanation of Aristotle's illusion given on page 227 of your text? Does the case of reacting to a blind-spot perhaps require for its complete explanation the application of both the principles of figure A and figure B on page 224 of your text?

XIII. *Binocular Rivalry and Co-operation.*

Read pages 245 to 255 of your text. Ask the instructor to give you a collection of cards suitable to test your partner's actions in case a *different* picture is presented to a corresponding region of his right and his left eye. The question in these cases is not simply "One or two?" It is to be taken for granted that your partner will always answer "One". Ask the instructor for a stereoscope so that you may easily present the picture on the right side to your partner's right eye and the picture on the left side of each card to your partner's left eye in such a manner that he will always look at the center of each picture and will always be inclined to say "One", in so far as this can be controlled by merely regulating the direction from which either stimulation proceeds toward the eye.

But how can he, the organism, call out "One" when one of the two organs in service at the time orders him,

the organism, to call "the thing" by one *name* and the other organ orders the same organism to call "it" by a *contradictory name*? You will notice that the organism escapes from this dilemma in one of three ways. Sometimes by the two organs (1) *compromising and thus in a way co-operating*. Sometimes by the two organs (2) *dividing the labor*, avoiding mutually an encroachment upon each other's division of the task, *and thus in a manner co-operating*. But sometimes the organs compete so fiercely that nothing is left to the organism to do but to carry out (3) *either all the time only the order of the one* or only of the other, *or to carry out alternately the order of the one for a little while only, then that of the other for a little while only, again of the one, again of the other, and so forth*. There is, of course, nothing absolutely contradictory in such an alternation. Do we not, free from contradiction, call, for example, the same field on a farm on alternate occasions a wheat field, a stubble field, a wheat field again, a stubble field again, and so forth?

In your partner's reactions to the cards of which your instructor gave you a set find examples (1) of the first kind of nominal co-operation above mentioned of the sense organs, (2) of the second kind of nominal co-operation of the sense organs, and (3) of the obvious competition of the sense organs. Of course, *true* co-operation between the two sense organs is such an ordinary fact in human life that you would not have to spend time in the laboratory in order to demonstrate it. Find these examples by showing to your partner the cards in the order mentioned here below.

Begin with the card which is pink on one side and

light green on the other. Place it in the stereoscope and let your partner adjust the stereoscope to suit himself. Give him ample time to look. Ask him if he ever calls the whole thing or any whole and uniform part of the thing "a pinkish green or a greenish pink". Ask him if he ever happens to be inclined to say that a veil is being thrown over the thing or that colored clouds appear on it. Ask him again and again how he would describe it now, and how he would describe it now, and how now, and how now.

Now be sure to read to your partner page 99, beginning with the last paragraph, and all of page 100 of your text. Then discuss with your partner whether his actions are more likely to be due to the law of the resultant or to the law of the competition of nervous currents. Was there anything in your partner's action that could be called a compromise? Was there anything in your partner's action that could be called a consistent and fruitful division of labor between the two sense organs? Was there anything that could be called fierce and never really ending competition? Which of the three ways of escaping from the dilemma (look three paragraphs back) is illustrated by this card?

In the same way now try on your partner the card of which one side is dark yellow and the other side blue. Ask and discuss the same questions.

Try now card 25 of "Titchener's Series". Is there anything in your partner's action which you would call fierce and never really ending competition? Or is there evidence that at least one of the eyes divides the labor so that it (I) leaves a certain task wholly to the other eye and (II) truly co-operates with the other eye in

everything else? Which of these two cases, I and II, would then be represented by *which* of the three figures on page 224 of your text? And which of the two cases, I and II, would be represented by the figure on page 105 of your text?

Try now card 26 of "Titchener's Series" on your partner. Is this case like that of card 25? Or almost like it? Or entirely different from it? If entirely different, what is the difference? If almost like it, what is the only difference?

Try card 27 of the same series. Answer the same questions. What are the best *conventional* (that is, agreeing with universal customs and not only with your partner's individual language customs) names which the two-eyed organism could pronounce for the whole thing regarded as something real, in the several cases of the cards 25, 26, and 27? Would "monogram" be a good name in one or more of the three cases?

Next try on your partner the card which is an enlargement of the figure on page 253 of your text. It is number 28 in "Titchener's Series". Read what you find on page 253 and 254. Do you find with this card any *true* co-operation between the two sense organs? Do you find any competition that is of the kind of nominal co-operation which may be called division of labor? Do you find any nominal co-operation of the nature of a compromise? What conventional name for the thing (or that part of the thing which is in question) does your partner propose in case you have an affirmative answer to the last of the preceding questions? What is gloss (or luster)? What adjective with three hyphens is used on page 254 of your text instead of "glossy"?

Would there be gloss in this world if "time" did not exist? What becomes of gloss when you photograph it? Did you ever see a photograph of the gloss of a person's spectacles? Do you still call it gloss in the photograph?

Try cards 29, 30 and 31. Does co-operation seem to weaken and competition seem to become fiercer as your partner passes from card to card? What must be the conditions of the streaming of excitation thru the nervous system which make deflection as described on page 105 of your text so rare a possibility with card 27 as compared with its probability in cards 29, 30, and especially 31? Can previous habit formation (resistance reduction as in the figure on page 124 of your text) have anything to do with these conditions?

Now give your partner card 32 to look at. Tell him that the apparent and maybe surprising "solidity" of the crystal is at the present moment a mere by-product which he may overlook since he will have a chance later in the course to demonstrate similar solidities on you, as you will then on him. Ask your partner which of the questions answered in the affirmative when he looked at card 28 have an application here, both with regard to the crystal and with regard to the background.

Give your partner cards 33 and 34 to look at and—as some people say—"psychanalyze" him, that is, listen to him carefully while he is talking himself out. Is there anything in his actions while looking at card 33 which you would call a demonstration of *true* co-operation of his two sense organs? Is there at times a nominal co-operation of the kind of a compromise? Is there at times one of the kind of division of labor? Is there at times any fierce competition resulting in the organism

alternately obeying the orders of the one only and then only of the other sense organ? If you answer any of these questions in the affirmative, write down exactly what part of the field of vision your answer refers to. Answer the same questions with respect to card 34.

Now use card 35 on your partner. We shall use this opportunity for discovering whether you are a good psychanalyst, that is, whether you have skill in guessing your partner's hidden habits about whose formation you have no testimony of witnesses. Does your partner's action make it probable that sometime in his life he acquired the habit of calling a real thing of a *certain description* by a *certain name*? Of what objective description, used by witnesses in court, say? Perhaps: being oval, with four legs, being blue, and now and then turning red? Or what other description? And by what name? Perhaps: a coffin? Or a rabbit? Or what other name? As soon as you guess what the hidden habit is, his prevailing reaction to card 35 will become quite plausible to you. When you have found the right *name*, pick out from our discussion of card 28 the *adjective* which is virtually, in some situation of life, the synonym of that noun. (Did your partner ever stand on the outside of a house looking at its parts?)

Now give your partner card 36. Do your partner's actions reveal any *true* co-operation of his two sense organs?, and where in the field of vision? Or any division of labor?, and where in the field of vision?

Card 37 will remind you of card 32 in this respect, that you may again believe it to be intended for the demonstration of an apparent "solidity". However, while the card might be used for that, that is by no

means the intention here. Ask your partner if he discovers *any gloss, any luster*. If he does, discover the objective cause of it. You can discover that, if you utilize what you learned on card 28. What you had there in a big bulk, you have here in many little details. But it requires a very minute inspection and comparison, a regular survey of the two pictures on card 37 in order to discover a few of these details. You will not find them either in the boat or in the shrubs on shore. But where most likely? (Where in the landscape would you expect gloss?)

Take now card 40, which is described on page 255 of your text. Read that page. Remember how your partner acted with the first two cards, when you put red before one of his eyes and green before the other, or when you put blue before one and yellow before the other. Do you conclude from your partner's actions that the competition between the nervous currents coming from the two eyes is *equally fierce now* when you put blue before the one eye and green before the other, or blue before the one eye and red before the other? Or is there a greater tendency toward a nominal co-operation in the two cases of card 40?

Would you accept the following threefold statement about the behavior of the nervous currents toward each other as an interpretation of your partner's actions?

With antagonistic colors:—competition most fierce.

With dissimilar colors:—competition much less fierce.

With somewhat similar colors:—competition still less.

Look up on page 283 of your text, in the lower paragraph, what colors are antagonistic. Do not fail to compare the figure mentioned there.

Look up on page 270, in the paragraph beginning on that page and ending on the next, what is meant by colors being "somewhat similar".

Now give your partner card 38, which is really only a double frame. By placing in the two windows of the frame bits of colored or uncolored and brighter or darker paper, you can try out any combination of excitations of the two eyes that you may be interested in.

Card 39 you can probably use most advantageously by instructing your partner to adjust the stereoscope so that the two inner (one blue, one red) squares coincide within what he will call "the real thing"; and that the two outer squares (one blue, one red) remain separate and upon the outskirts of that thing: Give your partner ample time to watch, and listen patiently to his description. What former experiences are here exhibited again?

Card 41 may call forth in your partner the application of the name "green" to a certain part of the field of vision, and you may have ready at once, as "explanation", the fact that *painters* often mix green paint out of blue and yellow pigments. Disillusion yourself. You will learn on page 273 of your text that the explanation is *not so simple*: Cut two holes in a white piece of paper, and cover thus all the red parts of the card, and let your partner look again. You will discover, unless your paper is translucent, that the red is the chief if not the only cause of the "green" being spoken of by your partner.

Card 42 will again exhibit some former experiences in a new variation.

XIV. *Stereoscopy and Pseudoscopy.**Stereoscopy*

Take a hollow truncated cone, made of paper or tin, and place it before your partner so that he can see the outside (that is, with the smaller of the two circular openings nearer to him than the larger opening). It is not necessary that the axis of the cone fall in the median plane. Indeed it is preferable to have the axis cross your partner's median plane under a small angle, say, one of ten degrees. See that your partner keeps his head as still as possible, while you make him close the left eye and draw with the pencil the two circles as they appear to his right eye in relative position, and then close this eye and, without having made any head movement, draw the two circles on the *left* of the drawing just made as they now appear to his *left* eye. Call this double picture for convenience's sake I.

Then turn the truncated cone around so that your partner can see its inside and make him draw again a double picture under the same conditions as before. Call this double picture II. Now ask the instructor to give you the cards of "Titchener's Series" from 1 to 24. Pick out from this series card 7 and see whether this agrees in its essential features with your partner's drawing I or with his drawing II. You can thus tell whether the person who drew the card 7 had the smaller opening of the hollow cone closer to himself or farther away from himself than he had the larger opening of the cone.

Now read what you find about stereoscopic vision on pages 256 to 260 of your text. *Memorize* the two rules which you find on page 258 in the lower paragraph be-

ginning with the word "Experience" and in the paragraph beginning below this and ending on page 259. Without knowing these two rules by heart your chance of understanding stereoscopy and pseudoscopy is practically zero.

Now let your partner place card 7 in the stereoscope which you get from your instructor. Let your partner properly adjust the instrument. Notice if he more frequently (if he speaks of "nearer" and "farther" at all) calls the smaller circle nearer or the larger circle nearer. (Of course, there is *no law of nature nor any statute law* which could *prevent* him from doing either.) Is the *greater frequency of one kind* among his reactions in accordance with the supposedly existing habit which you just memorized in those two rules? Or is it not in accordance?

Try now the cards 6 and 5 on your partner in the same manner. What is the likeness and what the only difference from number 7 of each of these cards?

Try now cards 4, 3, 2 and 1. Apply again the rules which you memorized. Then let your partner use these cards in the stereoscope. If you should find him less determined in these (simpler) cases, can you state a reason for that? Are the orders, so to speak, received by the organism to do something definite with the things shown on these four cards fewer than they are with the cards 5, 6 and 7, and do you regard this as a plausible reason why the organism does this definite thing with more vacillation? Do you "stick up your hands" with less vacillation when one highwayman orders you to do it or when several highwaymen give you the order?

Cards 8 and 9 do not introduce any new principle.

In card 8 there are two quite independent things to be seen at the same time. And in card 9 there are even five things, all independent, to be seen at the same time. All one can say is that these cards approach more the conditions of everyday life where, in seeing a furnished room or a landscape, one sees many things at the same moment.

About the same is to be said of cards 10, 11, 12, 13 and 14. The number of details seen at the same moment increases from case to case.

Now take the photograph, card 15. Try to apply the rules (which you memorized) by proceeding in your reasoning in the opposite manner. Instead of picking out two things or details which are quite obviously, one picture in comparison with the other picture, displaced relative to each other, pick out two things (without using the stereoscope at all) which are *quite obviously at different distances from the photographer*. Then measure their distance horizontally from each other in each picture.

With most things you select you will need a pair of compasses, calipers, or a ruler to take that measurement. But with a few wisely selected things you can measure exactly enough with the naked eye, without any calipers. To do that you must select two things which are almost exactly in line from the photographer, for example, the man and a point on the rail of the bridge just barely not hidden by his body.

Card 16 is a very interesting pair of pictures of the moon photographed from two laterally distant places on earth; but you will find it almost impossible to select two things on its surface for the same comparison which

you just made in the bridge pictures. The photograph 17, on the other hand, is again very suitable for such a comparison of two things with regard to their relative displacement in the two pictures.

Cards 18, 19, 20 and 20-Extra will give food for reflection to those students who are fond of it. But they will not elicit from your partner any very definite reaction when he looks at them in the stereoscope.

Cards 21 and 24 serve the negative purpose of calling attention to the fact that *only lateral* displacement of one thing relative to another (no vertical displacement) plays a role in stereoscopy. If you were the Creator and had made up your mind that in the race created by you *vertical* displacement should be a factor in "depth perception", how would you arrange your partner's eyes or what new eyes would you give him?

Cards 22 and 23 may elicit from your partner the remark that he is *more ready* to "imagine" (that is, to call) the thing on card 22 "a slanting oval" and also to "imagine" the things on card 23 "three (two round and one square) wire hoops of equal size, but in perspective" *if he closes one eye* than if he keeps both eyes open, in either case using the stereoscope. Why is your partner more ready for perspective vision (for "looking thru" the world) if he opens only one eye? In order to give the right answer to this question, you must first learn to give the right answer to the following question: What is the difference in meaning between saying "The lateral displacement is now zero" and saying "There is no lateral displacement existing"?

You actually will have, without needing for that any stereoscope (why not?), the same case as that of card 22

or 23 whenever you make your partner visit an exhibition of paintings. Imagine that you are the artist whose paintings are on exhibition. It might be to your interest, then, to advise your partner to close one eye. Why? When he visits your exhibition, are you very anxious to warn him against mistaking these wooden frames for window frames of some sort? Are you very anxious to keep him reminded that they serve to keep the pied canvases stretched flat? Or would you rather have him forget all about those canvases and call them window panes?

There are some curious kinds of "stereoscopic views" for sale in high class toy shops. With these kinds you do not look thru a "stereoscope" at all. With one kind you simply take the picture you have bought in your hands and look at it (apart from observing a certain rule about holding it) just as you would look at any picture. This kind is called "parallax-stereograms". With another kind you have to put on your nose a kind of spectacles differently colored for each eye. But again you hold—at least it seems so at the first glance—only one, and an apparently poorly printed, picture in your hand. This kind goes under the commercial name of "plastographical views". Ask the instructor for samples and explain how the stereoscopic effect is brought about in these cases.

Before leaving stereoscopy, you might answer the following questions concerning the common stereoscope, which are not strictly psychological questions, but whose answers may aid you on various occasions in life.

1. Since it is difficult to diverge or even parallel the eyes, why do the commercial makers of stereoscope

cards insist on making the *distance* of the pictures *from center to center* greater than the interpupillary distance?

2. What is that shape of the glasses put by the makers of stereoscopes into these instruments, which does away with the difficulty spoken of in the previous question?

3. The makers of stereoscopes make the prisms so that the real axes of your eyes converge at a point a goodly number of rods distant from you. Why do those makers dislike to have your point of convergence nearer? (Remember what kind of thing is usually photographed and viewed stereoscopically.)

4. Having your point of convergence at such a distance enforces an accommodation for the same distance, that is, makes you far-sighted. How does the maker of the stereoscope shape the prisms in order to overcome that far-sightedness of its user? (Inform yourself as to whether far-sighted people buy spectacles with convex or with concave glasses.)

5. Why does not the dealer in stereoscopes simply expect you to hold the photograph far enough from your eyes to suit your far-sightedness? (Why do not far-sighted people, when they want to read the newspaper, simply hold it as far from their eyes as the natural accommodation of their eyes calls for?)

Pseudoscopy

Pseudoscopy, as we use the term here, differs from stereoscopy, not by any discrepancy of principles (you use the same rules already memorized), but merely by the fact that you make your partner look at *a real thing* instead of at a double picture of a thing. You may,

when you read that sentence, think for a moment: "Well, that is then, nothing but what I do every moment of my life, having always real things before my eyes." True,—but for pseudoscopy it is necessary to have an optical instrument which you do not have every moment of your life. This instrument is *generalizingly* called a "pscudoscope". The word "generalizingly" is emphasized in the last sentence because you cannot go into a store nor even into a laboratory of physics and ask for a pseudoscope. That would be like going into a drugstore and asking for a "beautifier". There are many very different optical instruments which can be used to make a thing look "pseudoscopic". You will handle here only a few of the simplest ones.

Take first the so-called "total-reflection pseudoscope". Do not permit yourself to be confused by the word "total". That is a (physicist's) term which to you, here, is entirely irrelevant and only serves to characterize commercially the pieces of glass thru which you have to look. If you want to buy these pieces of glass, you have to order them under the commercial name of "total reflection prisms".

The best things ("real things") to use as objects to look at thru a pseudoscope are such things that, and placed in such situations that, neither the habits illustrated on page 241 nor the habits mentioned on page 244 of the text have a likely chance to function. In order to subdue the former, it is especially advisable to use a thing *no part* of which *hides* or *shades* any other part of it, and which is known to exist in this world in reversible forms. A bouquet of flowers, for example, would not serve at all, for some of its flowers are partly

hidden by others. Neither would a sculptured bust serve, for a human head appears always convex, never concave, and is therefore not reversible. But the hollow truncated cones, which we have already used, will serve very well, provided they are not placed so that one part hides another part, and provided the illumination is so diffuse that no part appears conspicuously shaded. If the illumination is troublesome, a model made of black wire and placed before a white wall is preferable.—In order to avoid the habits (p. 244) based on accommodation and convergence, it is advisable to avoid moving the eyes, that is, to *keep the gaze fixed* on a definite point while using the pseudoscope.

The simplest and best object to look at, however, consists of three cardboard targets, about two inches square (so far as they are visible), of different colors, so that one may easily speak of each under its color name, and also of sufficiently different size to avoid the suggestion that they are meant to be alike. Place these targets on a little table (say, fifteen inches square) which stands about five feet above the floor and which bears on its front a strip of wood or cardboard high enough to make it impossible to see the table surface on which the targets stand. Place the three targets in echelon so that none of them hides any part of any other, and one of them about four inches, one about eight inches, and one about twelve inches from the front of the table.

Give your partner the orders and questions of the following paragraph. These are not psychological questions at all, but are intended only to make him familiar with the instrument and to get the instrument adjusted:

“(1) If the distance between the prism tubes from center to center *differs greatly* from your interpupillary distance, move that prism tube which is fastened in a slot after you have loosened the bottom screw. But this adjustment is probably already made when you receive the instrument. Therefore, *do not play with it*. (2) Understand that the small round openings of the instrument are meant to be placed next to your eyes. (3) Look at the instrument from above and make sure that the prism tubes are approximately parallel. The screw on the right will *set them parallel* without any risk. (4) Look now with one eye only (closing the other eye) and convince yourself that by turning the prism tube within the larger tube holding it you can *tilt the target table*. (5) How many degrees do you have to turn the prism until the table appears upside down? (6) How much more do you have to turn in the same direction in order to make the table appear upright again? (7) Close the one and the other eye alternately and make sure that the prisms make the table appear *exactly upright to either eye*. (8) Look at a small object (a picture or a light fixture) on the wall ten or more feet away. With *both eyes open* turn the screw on the right until you see that small object clearly double; then turn the screw back until both those identical objects *exactly coincide* and leave the screw from now on alone. You and the instrument are now ready for our psychological demonstration.”

After having done all this to your partner, tell him to stand five or ten or more feet from the target table and to look thru the pseudoscope at the table. In all pseudoscopy demonstrations, if your partner ordinarily

wears glasses, make him wear his glasses. Tell him to *keep his eyes on one* of the targets (remember page 244) no matter what questions you ask him about the others. What are the reasons for keeping the gaze *constant* in every pseudoscopy demonstration? Ask your partner, now, which of the targets, using their color names, he would call the nearest and which the farthest. Write down his answer.

Tell your partner, then, to look at a person's *profile* alternately with the naked eye and thru the prisms and to tell you *what such a prism really does to the image*. Now look at page 258 of your text. Suppose that you had made the two drawings I and II looking with the naked eye, and that you had then made the drawings III and IV after looking at your finger and pencil thru such a prism. What would III and IV then appear like? *Redraw* in your note book III and IV in accordance with your partner's answer to the question *what such a prism really does to the image (profile)*.

Is it clear, then, that your partner could not help (if his targets were a finger and a pencil) *saying about the distance of the finger exactly that which normally he would say about the distance of the pencil?*

Human beings have this advantage over animals that they can "generalize" (some call it "reason"). Before you continue reading this manual, look up the page headings of pages 365 and 369 of your text. Let us see now how well you can "handle words". Let us see if, *instead of making a concrete demonstration* by putting the above question to your partner ("which of the colored targets, seen thru the pseudoscope, he would call the nearest and which the farthest") you could

have derived his answer by *merely handling words* (by "reasoning").

Take the two paragraphs, the one beginning with "Experience" on page 258 and the one ending with "vision" on page 259. Count how many times the words "right" and "left" appear in each paragraph in each of two significant connections.

Notice that these words appear in two different connections, sometimes in connection with "eye", sometimes in connection with "to the", meaning in the latter case lateral direction. Now, did you ever take your partner's *eye out of the socket* and put it in the other socket? Not at all. Therefore do not do anything to the words "right" and "left" in the two paragraphs whenever they appear connected with "eye". But when they appear connected with "to the" you should exchange "right" and "left", if your partner uses an instrument that "changes the profile".

Now make your partner handle the words "right" and "left", exactly as prescribed, in the first paragraph after the words "might be called". That is, make him rewrite that passage which is in quotation marks in his note book in its new formulation. *Compare the result* with what the *unaltered second paragraph* states. Do you see now the agreement between your former *concrete demonstration* of your partner's actions and his present *abstract reasoning (handling of words)*?

Your partner's abstract reasoning, quite aside from its value as exemplifying the discussion of chapter XVI of your text (by the way, what is the title of that chapter?), has a direct value for you in suggesting another kind of concrete demonstration of pseudoscopy by

means of another instrument to be put before his eyes. Make your partner, for a change, rewrite again that same passage of the first paragraph in question. But make him rewrite it this time by doing nothing with the words "right" and "left" when they appear connected with "to the", but by exchanging "right" and "left" whenever they appear connected with "eye". Compare the result with what the *unaltered second paragraph* states. Do you expect from this *mere reasoning (handling of words)* that you will again succeed in a *concrete demonstration* of pseudoscopy by means of a new method?

For this demonstration, then, it is necessary to remove at least one of the eyes from its socket. Let us, *without breaking any of the nervous connections*, remove your partner's left eye and put it several inches to the right of his right eye, so that his *so-called* right eye will *function* as a left eye (that is, on the other eye's left side) and his *so-called* left eye will *function* as a right eye (that is, on the other eye's right side).

We shall not, of course, perform this operation by means of the surgeon's knife, but simply by placing before your partner's left eye a little mirror which breaks the line of sight rectangularly and throws it to the right, and by placing a second, preferably larger mirror, on the right side of his head, but a little in front, in order to break the line of sight again. What he really sees of our target table with his *so-called* left eye is then that aspect which can be seen from the position of the larger mirror, that is, from a position on the right of his *so-called* right eye. The *so-called* right eye then functions as a left eye in the stereoscopic sense.

Tell your partner to place his head so that his left eye has the little mirror in front obstructing the view, and so that at the same time the right eye sees the target table freely. Tell him, then, without changing the position of his head, to take hold of the larger mirror and swing it around its pivot until the target table appears clearly double, and to swing it back until the target table appears single. Your partner and the instrument are now ready for the psychological demonstration, the demonstration of his habits. Ask your partner which of the targets, using their color names, he would call the nearest and which the farthest.—The “reason” for his answer you have known already for some time, even before asking the question. That “reason” was your very inducement for constructing this second kind of pseudoscopic instrument. Let us call this instrument an “eye transplanting” pseudoscope.

The “reasoning”, that is, handling of words, which you have employed and which has just been referred to again, ought to make it plain to you that *all possible pseudoscopes* must belong either to the one or to the other of *only two chief classes*. That is, either the profile of each eye’s image is reversed in a lateral sense; or the profiles are left unaltered, but that of each eye is given to the other eye. No third class is thinkable co-ordinate with these two classes of pseudoscopes.

If you are familiar with the appearance of images on the photographer’s ground glass plate, this might suggest to you the construction of a third kind of pseudoscopic instrument, subordinate to the first of the two classes just mentioned. Ask the instructor to show you a “lenticular pseudoscope”, and use it on your partner.

Now try again a little "reasoning". In the first of those two paragraphs on page 258, make your partner exchange the words "right" and "left" *everywhere* no matter what their connection. How does the resulting statement compare with the unaltered statement of this same paragraph, and how with the unaltered statement of the other paragraph? Do you expect your partner to act "pseudoscopically" in such a case?

You can make the demonstration corresponding to this "reasoning" by giving your partner both a pseudoscope of the first class and a pseudoscope of the second class to look thru at the same time, in combination. (You can also make the demonstration by standing your partner before the target table so that a *mirror* on the wall is about half way between him and the table and *parallel* to the line running from him to the table. Then make your partner see the table, not directly, but in the mirror. If you are fond of geometrical drawings, prove that you have then a combination of both pseudoscopic effects, that is, a double reversal of habits and thus no change of habit at all. But if you are not fond of geometry, we do not require you to do it.)

Now select whatever pseudoscope you have come to like best and let your partner look at the truncated hollow cone with which you are already familiar. Ask him if the pseudoscope does not make the cone (quite aside from the pseudoscopic effect) *more* deserving of the name of (whatever the case may be) either "nearly cylindrical" or "nearly funnel-shaped" than it would *normally* be. Explain that fact by recalling what you learned from demonstration X. (What changes in "size" make a funnel out of a cylinder?)

XV. *Bright-Dark.*

Read to your partner what you find about the Bright-Dark substance (or Black-White substance,—it means the same) on page 264 of your text. Then cut out of black paper a parallelogram about an inch or two wide and about four inches long. Then cut from the center of this a smaller parallelogram so that a kind of black frame of about $\frac{1}{4}$ inch solid width remains. Fold the shorter pieces (the ends) of this frame upon themselves to stiffen them. Then fasten one of the long pieces of the frame with pins upon black velvet cloth lying on the table, and bend the other long piece slightly up so that you can easily slip a piece of paper under it. Put a pin in the center of the frame and order your partner to look steadily at the pin-head and to continue doing that no matter what you do or ask him.

While he is thus engaged, slip a piece of white paper larger than the frame under the free half of the frame, about as far as that pin-head. Slip out the white paper again. Slip it under again. And so forth repeatedly. See if you can do this fast enough or slowly enough—experiment!—to induce your partner to say that the one half of the frame “differs” from the other half “in darkness” whenever the white paper is slipped under.

What statement made on page 264 is demonstrated by that action of your partner which you have just called forth by your manipulations and your questioning?

What two regions of the large part of the moon unilluminated by the sun—compare page 263 of your text—correspond to the one and the other half of your dark paper frame?

In spite of the "opposition" of the Dark (or Black) excitation and the Bright (or White) excitation, these excitations are not antagonistic to each other in the sense that one would cancel or destroy the other and the one alone would be left. On the contrary, they are capable of coexisting in one and the same sensitive cell, as can be proved by the fact that in such a case the name of "similar" can, in comparison with the cells where they coexist, be applied to both the excitations in sensitive cells where the Dark excitation alone occurs and the excitation in sensitive cells where the Bright excitation alone occurs. You will now demonstrate this on your partner.

Take a small disk of, say, $2\frac{1}{2}$ inches diameter and of rather dark (vulgarly speaking black) paper. This will serve as the stimulus for those sensitive cells where you want the Dark excitation alone to occur. Put this disk on another disk of 4 inches diameter and composed of a black and white sector. Put this combination of the $2\frac{1}{2}$ inch and the 4 inch disk on a third disk of $5\frac{1}{2}$ inches diameter and of white paper. The white ring left free of this largest disk will serve as the stimulus for those sensitive cells where you want the Bright excitation alone to occur. When you spin the set, you give your partner three rings to look at. The smallest disk also appears as a ring, for the brass screw of about 1 inch diameter covers the center. Each of these three rings is about $\frac{3}{4}$ inches wide.

The middle one of the three rings is the one about which we asserted that your partner might call it similar to both the outer, bright ring and the inner, dark ring. If our assertion is true, we can also express it by saying

that "obviously the two excitations Dark and Bright in spite of their opposition, the first mentioned fact, are not antagonistic in the sense of exclusiveness, but, second fact, are capable of coexisting in one and the same sensitive cell.

Demonstrate this on your partner by instructing him to adjust the white sector and the black sector of the middle ring until he is willing to say that the result is *equally* similar (or *equally* dissimilar) to both the white and the black ring, that is, until he can *no longer* say that the resulting gray *resembles one* of the two other rings *less* than it resembles the other. It is clear that, as soon as your partner has called the gray "*equally* similar" to the white and the black, he has also admitted that it is perfectly sensible to call it "similar" to the white and the black.

Recalling again what you did in demonstrating the "opposition" of the Dark and Bright excitation, you ought to impress upon your memory that this "opposition" goes among psychologists often under the name of Dark-Bright *contrast*, and also under the name of Dark-Bright *induction*. Adopting the latter term, you can restate the description of the demonstration just made on your partner with the rings of the color-wheel, by saying that the Bright excitation and the Dark excitation "mix", or that a gray is "a mixture" of colorless dark and bright (or "a mixture" of black and white), *in spite of* this mutual induction. You may wonder why your teacher or the author of this text makes such a statement, which is "so obvious". You will convince yourself in demonstration XVI that this is "not so obvious", for you cannot state the same for

the Blue excitation and the Yellow excitation. You will find there "no mixture" *because of* the mutual induction.

Read now the first paragraph on page 290 of your text and demonstrate, together with some of those facts which you have already demonstrated, the "negative after-images", so-called, resulting from exposure of your partner's eye to black and white papers. (The "positive after-image" you will study in a later demonstration.)

Place a large sheet of white paper on the table. Place the two halves of a sheet of black paper of similar size so that between them a strip about half an inch wide of the white paper is visible. Place a pin-head or other small object on the white strip as a fixation mark for your partner's eyes. Now let your partner keep his eyes steadily on that mark for a considerable time. When he tells you that the black is no longer as dark as it was at the first moment (compare "general adaptation" on page 291 of your text), remove the black sheets. Ask your partner, before, not to move his eyes from the mark if you should move the black sheets. Ask him, now, while he keeps his eyes on the mark, to describe the appearance of the narrow strip. The negativity of the after-image of the narrow strip will probably be quite clearly expressed in the words which he uses. Proceed in the same way except exchanging the relative positions of black and white. Do both these experiments over, but leave the papers untouched and simply make your partner, when he has exposed his eyes long enough, cover his eyes with his hands and describe (with a little patience) the appearance of the

after-image of the narrow strip. In order to give your eyes a chance for rest, you and your partner may make these experiments alternately on each other. The negativity of the after-excitation in these cases is theoretically much less plausible than the negativity of the "successive induction" phenomena in demonstrations XVI and XVII, where you will have true antagonism, while between the Dark excitation and the Bright excitation there exists, as already stated, no true antagonism, but only a peculiar opposition.

XVI. *The Antagonism, of Blue and Yellow.*

Read the lower half of page 277 and the whole following page of your text and then proceed in exactly the same manner in which you proceeded in demonstration XV making up of black and white three equally broad rings, with this difference only that you use blue instead of black and yellow instead of white. Instruct your partner to adjust the sectors of the middle ring until he is willing to say that the result is equally similar to both the blue and the yellow ring. You will observe that he can not carry out your instructions, that he will never say that the result is similar to both the blue and the yellow. He will always call it (more or less) similar *either* to one *or* to the other, but never to both,—never both yellowish and bluish. However, he can be made to say that the result is similar to neither the blue nor the yellow, that is, that the middle ring no longer deserves the name "bluish" nor the name "yellowish" either, *while having a certain adjustment of its sectors*. Let your partner find this relation of the sectors and, in order to have a definite record of what your partner has

done, measure in hundredths the relative size of the two sectors.

Now try to demonstrate on your partner what is described on page 274 and on page 275 as far down as "general adaptation". After having done this with a large sheet of yellow paper, repeat the demonstration with a large sheet of blue paper.

Read next the last two paragraphs on page 276 of your text and try to demonstrate the facts mentioned there. Put a piece of yellow or blue paper, two or three inches in diameter, on a fairly colorless (fairly "neutral", as we may also say) table and observe whether your partner acts as your text states.

Now repeat the last demonstration with this difference. Fill the whole field of vision absolutely with only one color, either yellow or blue. You can do that best by taking a box, a little larger than your partner's head, but having both the bottom and the lid removed. For the bottom substitute a piece of transparent colored glass. Then make your partner put his face into the box while holding the box up conveniently with his hands. Cover box and head with a large black cloth, in the photographer's manner, in order to keep your partner from seeing anything *reflected* on the glass, for reflected rays are not changed (filtered, colored) by the glass. Then let him look out thru an open window upon a landscape containing houses, trees, streets and a variety of other things. Wait patiently until your partner has the experience, already demonstrated, of "general adaptation". That is, you wait until he reports that the originally quite discolored landscape begins to look natural again. Then take the whole box away and at that moment ask him whether the land-

scape immediately became discolored again, and in what coloring. You have thus demonstrated again "successive induction". (By the way, do you recall what other term, synonymous with successive induction and found, for example, on page 291 of your text, you used in demonstration XV?)

Read next page 277 of your text. Take a large gray disk and place another disk, less than half the size, and either blue or yellow, on the gray disk. Then spin the whole set on the color-wheel. Instruct your partner to keep his eyes steady on the center of the wheel and to report to you the marginal effect on the large gray ring.

Then demonstrate the same fact in such a manner that two opposite margins overlap. Take a yellow and a blue piece of paper, of note paper size or larger, and let the edge of one lie on the other paper so that there is nothing between the two colors. Then take several strips of neutral gray paper, about $\frac{1}{8}$ or $\frac{3}{16}$ of an inch wide, some darker, some brighter, preferably cut in zigzags or serpentine rather than straight, and place them so that half of each is on the one, and half on the other color. Cover the whole with tissue paper and ask your partner what color names he would give to those strips, and whether these names apply only to the margins.

Demonstrate the same fact again as follows. Take a yellow disk of $3\frac{1}{4}$ inches diameter and place it on a disk of 4 inches diameter composed of a large black and small white sector. Then place the combination again on a yellow disk, of $5\frac{1}{2}$ inches diameter, or larger. Spin the wheel and ask your partner what color name he would give to the narrow ring composed of

a black and white sector. Let your partner adjust these sectors to each other until he is more ready than ever to apply that color name. Then spin on a second color-wheel a combination of black, white, and blue sectors of any size disk, and have your partner adjust the sectors so that he would call the color on this second, solid-faced wheel a perfect match to the color of that narrow ring on the first wheel. Measure, in hundredths, the sectors of the second color-wheel and record the values in your note book. You thus get a measurement of the strength of the induction.

Do again what you were told in the last paragraph, only using blue instead of yellow. By what names is this phenomenon referred to in the middle of page 291 of your text?

Repeat the last two cases, of a narrow gray ring on a yellow or blue background, with *very unsaturated* colors. For example, instead of two saturated yellow disks use two disks of which each is a like combination of only 25 per cent yellow and 75 per cent gray. Use a gray of a brightness (of a "darkness", if you prefer to say so) as near as you can find in the laboratory gray paper disks like the brightness (darkness) of the colored paper with which you desire to combine it. Spinning the wheel and matching the narrow ring's color on a second wheel showing a solid face, how much blue do you need on that second wheel? Measure. You will be surprised when you compare this with your previous result at the strength of the color induction even when the inducing color is rather unsaturated.

XVII. *Red-Green and the Entire System of "Sights"*.

That which "sounds" we call "a sound". We need in psychology a simple term for that which "looks". Let us, as the heading suggests, call it "a sight".

Proceed exactly as you did in the first paragraph of demonstration XVI, except that you substitute *red* for blue and *green* for yellow. Let your partner adjust the sectors of the middle ring until this ring is *no longer* called by him *reddish nor greenish either*. Then remove the largest and the smallest disk and retain only the middle size disk composed of a red sector and a green sector. Ask your partner if that ring, after having thus become a whole disk which is neither reddish nor greenish, can be called colorless, a neutral gray. If he replies in the negative, ask him further whether he would prefer to call it yellowish or bluish. If he prefers the former, give him a blue disk of the same size (if he prefers the latter, then, of course, you give him a yellow disk,—always the antagonistic color) and let him add it as a third sector to the other two sectors, the red and the green.

Now place the disk, composed of red, green and that third color on a larger colorless disk of, say, $5\frac{1}{2}$ inches diameter, composed of a white and a black sector. Spin the whole and show your partner the gray ring surrounding an inner, more or less colored field. If everything you have learned theoretically about your partner's visual sense (read especially page 281 of your text) is correct, it must be possible to adjust the white and black so to each other and also the inner three sectors so among themselves that he will call the whole disk, when spun, "homogeneous". Let him very carefully and patiently make these adjustments; and then

measure the five sectors and write the result in your note book in order to have a record of what you have here demonstrated about the relation of the Red-Green substance to the Blue-Yellow substance.

Read now the lower half of page 283 and all of page 284 of your text and then give your partner the four (Why not six? And why is this question asked?) tasks, one after another, of producing on the color wheel *a dual color, in a middle ring*, so that this dual color *resembles equally* (no more nor less one than the other) its two *singular colors* which are to appear on the *inner* and on the *outer ring*. Choose the disks so that the three rings are approximately of equal width. For example, use diameters of $2\frac{1}{2}$, $3\frac{1}{4}$, and 4 inches, or of $2\frac{1}{2}$, 4, and $5\frac{1}{2}$ inches. When your partner pronounces the resemblance equal, measure the sectors for your record and proceed to the next of the four tasks.

Read now page 285 of your text and proceed to demonstrate on your partner the necessity of using for the representation of the entire system of "sights" a graph or model of *three* dimensions. In order to demonstrate this you must obtain a small disk of a saturated color (choose a *dual color*, in order to get rid of the idea that for demonstrations of the system of "sights" you are restricted to the use of singular colors); place this on a larger disk composed of two sectors, one of the same saturated color and the other sector a gray neither much darker nor much lighter than it; and place this set again on a larger disk of the same gray. The absolute size of the triple disk does not matter; but make the three rings approximately equally wide. Spin. Ask your partner to locate that line (that is, the two end points of that straight line) on which

the three "sights" of your color-wheel are ideally found in the three octahedrons of your text and also in the painted and hollow model in the laboratory.

In the preceding paragraph, however, you have not yet demonstrated the necessity of using a graph or model of *three* dimensions. Your partner could still locate every name used by him within the color square. But give your partner now two black disks to substitute for the two gray disks of the preceding paragraph and let him spin these on the color-wheel; give him also two white disks and two colored disks as before, to spin on a second color-wheel. Ask him to vary the sectors of the middle ring on both wheels to suit himself and then to locate the line for the one wheel and for the other wheel on which the "sights" of each wheel are ideally found in the octahedrons and in the model. Now he can abstain from using a third dimension of the graph or the model only if he is willing to restrict himself to the single chosen color. In the preceding paragraph he remained within two dimensions no matter how many different colors he desired to use.

Before you dismantle the two wheels used in the last paragraph ask your partner whether the coloring of the middle ring is as easily detected in mixing 10 per cent color with 90 per cent black as in mixing 10 per cent color with 90 per cent white.

Now read the last paragraph of page 286 of your text. Ask the instructor for a gray screen with a half inch hole and a horizontal scale (a campimeter or perimeter); also for a head-rest, a pointer, and four sheets of paper: orange, violet, olive, and peacock. Fix your partner's head so that, if he now looks thru that hole, he sees the space of the hole completely filled in with

the color of one of those sheets. The sheet must be well illuminated and have no shadow on it. Therefore keep yourself as well as other things out of the light. Arrange the gray screen so that its scale lies on the right, provided your partner intends to use his right eye; think it over and convince yourself that, otherwise, when your partner looks at different points of the scale, the hole might fall on the blind-spot of his right eye. Let the perpendicular distance from the eye to the campimeter be about six inches and keep this distance constant during all the tests.

Now ask your partner to close his left eye and to turn his right eye along the scale until the hole becomes invisible. Put your pointer at this point of the scale and move it slowly along the scale toward the hole until your partner, who *follows your pointer with his eye*, and who is not permitted meanwhile even to glance at the hole, tells you that the hole has not only become visible (it will first appear as a neutral gray), but that it has just taken on a definite *singular* color. Record that point of the scale in your note book.

Continue moving your pointer with a speed which your partner finds agreeable, until he tells you that the hole has just taken on the dual color to be expected. Record that point of the scale.

Repeat the same procedure with the other three sheets of colored paper which we selected.

Now put your pointer near the hole and ask your partner, who follows the pointer with his eye, to stop your motion of the pointer receding from the hole by telling the very moment when the dual color changes to a singular color. Record the distance from the hole as measured on the scale.

Continue moving your pointer at a suitable speed until your partner tells you that the singular color of the hole has just given way to a neutral gray. Record that point of the scale.

Repeat the same procedure with the other three sheets of colored paper.

Take now the average of the eight scale points at which the changes occurred between a dual and a singular color. Take further the average of the eight scale points at which the changes occurred between a singular color and a neutral gray. These two averages give you an idea of the relative extent of the inner area of the dual colors and the surrounding area or zone in which only the singular colors blue and yellow are easily recognizable.

That the eight measures giving each average vary as much as you will probably find them to vary, is due, among other facts, to the fact that the Red-Green substance and the Blue-Yellow substance do not have a very sharp border line, but fade out somewhat gradually from more central to more peripheral parts of the retina.

If you have a clever partner and are yourself clever enough, you may devise a method of demonstrating also the fact that, when a dual color stimulus passes out of your partner's blind-spot, he is likely to give it first the name of a singular color and then only the name of a dual color, just as on the passing of a stimulus from the peripheral to the central regions of the retina. But this demonstration is much more difficult and we do not urge you to undertake it.

Now we are going to give you six tests in order to find out what you have learned in demonstrations XV, XVI

and XVII about human reactions to qualitatively varying sights. Perform the following six tasks and tell in your note book exactly how you performed them.

(1) *Match in darkness-brightness* two equally broad rings of the color-wheel,—one ring being any (singular or dual, to suit yourself) *saturated color* which happens to be a rather dark color whenever saturated, and the other ring being such an *unsaturated color* (singular or dual) as happens to be a rather bright color whenever saturated, but which you have darkened by the addition of a black sector for the sake of matching.

(2) *Match in darkness-brightness* two equally broad rings of the color-wheel,—one ring being any (singular or dual) *saturated color* which happens to be a rather bright color whenever saturated, and the other ring being such an *unsaturated color* (singular or dual) as happens to be a rather dark color whenever saturated, but which you have brightened by the addition of a white sector for the sake of matching. Why is the regular octahedron only an approximation to the true form of the color pyramid?

(3) Let three *equally broad* colored rings of the color wheel *differ only in darkness-brightness* (not differ also in coloring nor in saturation either). Use for the intermediate ring a 50% sector of gray, for the inner and outer sector black (for either one) and white (for the other sector),—black and white in quantities to be found by matching the degree of saturation of the three rings. What quantities did you use? And on what line, parallel to what, are these three points in the octahedron?

(4) Repeat what the last paragraph instructed you to do, with this exception that, if you used then a singu-

lar color, use now a dual color; or, if you used then a dual color, use now a singular color.

(5). Let three *equally broad* rings differ strikingly in color, but not at all in darkness-brightness; and pay no attention whatsoever to the question how saturated the colors are, save that one (only one) of the rings must have its maximum of saturation.

(6) Repeat what the last paragraph instructed you to do, with this exception that, if you used then a majority of singular colors among the three, use now a majority of dual colors; and if you used then a majority of dual colors, use now a majority of singular colors.

XVIII. *Some Ghosts.*

It goes without saying that the marginal effects of local adaptation, and still more the negative after-images, and most the positive after-images have been occasions, in the history of mankind, for "seeing ghosts". A person who stares at another person (remember what you have learned in demonstration V and on pages 249 and 291 of your text as to whether such a functioning of human eyes is normal or not) may very well see the other person surrounded by an "aura". An after-image is still more likely to be regarded as a ghost by superstitious people than a simultaneous outer margin of a person's figure. Therefore the title of this chapter. Demonstrate now a few particularly striking cases of successive induction of sights.

Take your partner into a room which has only one window. Let him look steadily for about a minute at the window cross or simply at a definite point of the cross-bar of the two sashes if there is no cross. Then make him cover his eyes with his hands, keep his eyes

steady, and report to you during the next minute what things there are visible. Now read the last paragraph on page 290 and the first paragraph on page 291 of your text. If your partner has not reported to you everything mentioned there, repeat the experiment and make him look at that window cross twice as long.

Now take your partner into a perfectly dark room and keep him in the dark two or three minutes, until his eyes have become sufficiently adapted. Then tell him to look in the direction in which he knows there is an electric fixture. Turn on the light of a single bulb, and after your partner has looked at it for a short time turn off the light again. Ask him to report whatever there is now visible, patiently. If his answers do not satisfy you, repeat again as in the preceding paragraph. While still in the dark, move a glowing match in a circle or in other curves. Your partner's reports will help you to answer the question: "Why do shooting stars always have a tail?"

Now go to a dark room where you have a "Herring window", that is, no other illumination than that which comes thru two parallel narrow slots six or twelve inches apart, one having a colored, the other a ground glass pane. Use a parallel ruler and throw four shadows, close together, on a white or gray sheet of paper conveniently arranged opposite the window. Two of these shadows (which?) ought to be colorless; but they are not. And the ghost-like aspect of the case consists in the fact that, if the relative width of the window slots is well adjusted to the transparency of the glass, your partner can not tell which two of the four colored shadows are the *real* things and which two are the ghosts. So you see that there may be some excuse for

the reports of some people in the history of mankind that ghosts had *really* made their appearance.

A somewhat similar and again very striking demonstration is that made with the rings in the box which you will now obtain from your instructor. Some of these rings are strongly colored because no white light is reflected on them. They are, so to speak, shaded. Some others ought to be virtually colorless because no light ("no-light" equals black) is sent thru the light sifting and thus color producing glass. If these latter rings appear colored, they deserve to be called ghost colors. You will find again that your partner, if the adjustments are well made, can not tell which are the *real* colors and which the *ghost* colors.

There is a *summation of two effects*, (1) the bright-dark opposition, or call it contrast, between the shaded and the non-shaded portions of the background, which becomes here a phenomenon of nervous deflection with consequent failure to react to the existing color excitation of the *non-shaded* background portions, and (2) local adaptation for the alternating rings. It is this *summation* which makes the ghosts in this case and even more in that of the Hering window so realistic. If there were an adequate motor reaction to the coloring of the whole background, too, the ghost would be much less realistic.

XIX. *Tone Induction and What it is Good For.*

When there are currents of electricity where nobody poured out any, we speak of electricity by induction. When there is color according to your partner's testimony, altho you did not in any sense pour out any color there, you speak of color by induction. You might then

very well accustom yourself also to speak of tone by induction, when your partner reports the presence of a tone altho you did not pour out any such tone, while indeed pouring out other tones. Electricity may induce electricity, color may induce color, tone may induce tone.

Read to your partner what you find about tone induction in the last paragraph on page 307 of your text. Then sound the two Galton whistles by filling the large bellows completely with air and letting the bellows go down without working it, in order to avoid every disturbance by noise. Fill again and let down again. And so forth. The bellows, being large, gives air for a considerable time when completely filled.

Sound a tuning fork (one of 300 full, so-called double, vibrations will do) by tapping it gently with your finger or a felt hammer, and ask your partner to remember the tone. Let him hum the tone if he wishes. Then *stop the fork* by touching it, and make your partner change one of the whistles until the induction tone is just like the tone he was humming. He can not do that while the fork is sounding, because the fork tone would "swamp" everything. There is no danger that your partner might confuse one of the two whistle tones with the induced tone. The latter, even if out of tune with the fork tone and much higher, is too mellow to be mistaken for the exceedingly high, very shrill, tones of the Galton whistles. "Shrill", however, does not mean very loud, but "sort of pointed". Thus your partner's task consists only in *listening to the induced tone and making it equal to the tone he was or is humming*.

By the way, if you have studied physics, we must warn you against confusing a certain physical phenom-

enon with what we have called an induction tone, that is, with an "induced" sensory and nervous excitation. You find in the literature of physics frequent references to "combination tones, summation tones, *difference* tones, asymmetry tones" and other acoustic phenomena of a similar kind. These are all characterized by the fact that some *unsymmetrical* elastic body, a certain reed, a certain air volume, an auditory tympanum, an auditory ossicle in its peculiar bearings, etc., is forced at some time to vibrate with unusual vigor; and then certain phenomena occur, deducible from differential equations, not incomparable to the planetary aberrations of the astronomers. The not infrequent confusion is due to the fact that *the induction tones are also a kind of difference tones*. Look again at page 307 in order to tell why they may also be called difference tones.)

Since the induction tone is a kind of *difference* tone, you can tell by "reasoning" (remember chapter XVI of your text) that there must be a second position of the piston of the same whistle when the induction tone will be exactly the same. Find that second position. Make your partner turn the piston so that the induced tone becomes lower. Make him continue turning, very slowly, in the same direction, while he reports to you that the tone becomes still lower, momentarily disappears, then reappears very low, then rises more and more and finally again equals the fork tone. Aside from being good practice for your partner and satisfying your natural curiosity this procedure of finding the second position has no particular virtue.

When the induced tone is well tuned and in unison with the fork tone, your partner ought to report that

there are "beats", provided the simultaneous fork tone is neither too strong nor too weak. The intensity has to be tried out. They are *irregular* beats on account of the slightly inconstant air pressure in a collapsing vessel made of wood and leather. Such slow beats may be used by your partner as an indication that he has about finished what you asked him to do. Such slow beats are therefore of great practical value to the professional tuner of instruments.

An interesting variation of this procedure, of *demonstrating an induced tone by having somebody tune it*, is the following. You take two tuning forks, say, of 600 and of 525 (complete) vibrations. You bow these forks with a bass bow to make them sound very strongly and keep them sounding very strongly. This requires some skill in handling the bow without tearing the horse hairs by letting the hairs slip off the end of the tine which you are bowing. (You never touch more than one tine.) Keep at a safe distance (about $\frac{1}{2}$ inch) from the end of the tine.

Now give your partner a big tuning fork with adjustable weights, variable between, say, 60 and 100 vibrations, and tell him to adjust the weights until the tone of this big fork is equal to the induction tone of the two smaller forks which you keep sounding. Do not separate the weights much from each other; if you do that, the fork will not sound well. Your partner should again utilize the beats, which in this case will fortunately be very regular, in order to notice that he is approaching the goal which you have set for him.

Tell your partner to show, by beating the air with his finger, the exact tempo of the beats. Then let him, by tuning the big fork, slow up the tempo of the beats

until there are no beats left. This is good practice, helpful in the task of tuning at any later time any musical instrument.

Now let your partner apply his knowledge of the induction ("difference") tones to the very practical problem of finding the ratios in which the tones of the white keys of a certain stop of the laboratory organ are tuned. If we could afford to have you and your partner *tune* the organ, this would be still more interesting. But since in all probability you would rather *mistune* it, we restrict you to *finding out in what ratios it actually is tuned*. Start with the ratio of a high *f* to the following *g*, and determine all the ratios as far as the next *f*.

First sound *steadily* *f* and *g* simultaneously, and let your partner, listening to the low induction tone all the time, discover what tone that induced tone is by *momentarily* pressing down one of the white keys on the left of the keyboard. That is, your question is: If $g - f = x$, what is x ? Your partner tells you. Then remember that the ratio of octave tones is always 1:2, and try to express x as a function of either *f* or *g*. As soon as you have substituted this in the above equation, you can, after dividing the whole equation by *f*, answer the question: What is the ratio $g:f$ numerically? Your first problem is solved.

Now sound *steadily* *a* and *g*, and let your partner discover what white key on the left of the keyboard is x in the equation $a - g = x$. Then try to express x in this equation as a function of *g* (remembering the result of the preceding paragraph, without which you could not do it). Divide the whole equation by *g* and answer the question: What numerical value do you get for the ratio $a:g$? Your second problem is solved.

In a similar manner determine the ratios $b:a$, $c:b$, $d:c$, $e:d$, $f:e$. You will then have a definite idea as to how an organ tuner would proceed, when the reeds or pipes are still untuned, but the ratios are given to him. You notice that the existence of the induced tone has a high practical value.

XX. Voiced and Voiceless Speech Sounds.

The following demonstrations may be more striking if you can make them on your partner *before he has read the following list* of words. The demonstration may be quite successful, however, even if he has already read the words in the list. Besides, it is always possible for you to try the same demonstration on some friend who is not one of your classmates and who is unacquainted with the list.

In order to understand what you are going to demonstrate, read pages 313 to 319 of your text.

Give your partner a sheet of paper and ask him to write down quickly, without hesitation, the number and the word which he understands whenever you pronounce a cardinal number (from 1 to 50) and the word in the list belonging to it. However, instead of making him write the whole word, be satisfied if, in order to save time, he writes only the first two or three letters, just enough for later identification.

Now read to him the list, carefully observing every condition below mentioned. (1) Be sure that you *whisper*, that is, that your *larynx is wide open* all the time and never offers the slightest avoidable obstruction to the passage of the air. (2) Do not try to speak loud, for, if you do try, you will surely not whisper. But be sure that you do not make the first sound of

each word (corresponding to the black-faced letter) weaker than the following parts of the word. Rather *give the black-faced part of the word more emphasis* than the others. But remember always that the whole word is to be whispered.

The experiment, in addition to its demonstrational value, will serve you as a test of your ability to carry out the instructions given above. The fewer errors your partner shows in understanding you, the less capable you are in following those instructions.

Do not wait long after having pronounced each word. Give your partner barely time enough to jot down the number and two or three letters before you give the next number and the next word. When you have finished the fifty words, compare your partner's list with your list of words. Mark in your partner's list all the words misunderstood. A comparison, then, of the words misunderstood with those well understood ought to reveal clearly what speech sounds ("letters", as we vulgarly say) of the English language can not be produced unless they are voiced.

- | | |
|--------------|-------------|
| 1. smith | 14. vile |
| 2. plumber | 15. rooster |
| 3. carpenter | 16. grow |
| 4. dinner | 17. gill |
| 5. sick | 18. joke |
| 6. veal | 19. rope |
| 7. light | 20. span |
| 8. bride | 21. stake |
| 9. write | 22. dent |
| 10. woo | 23. hound |
| 11. zeal | 24. whip |
| 12. boast | 25. wine |
| 13. letter | 26. die |

- | | |
|-------------------|---------------------|
| 27. bull | 39. river |
| 28. bush | 40. Greek |
| 29. meat | 41. Chinaman |
| 30. eat | 42. Russian |
| 31. junk | 43. dirk |
| 32. mouth | 44. fork |
| 33. nose | 45. knife |
| 34. gin | 46. apple |
| 35. milk | 47. gore |
| 36. cheese | 48. furnace |
| 37. girdle | 49. goal |
| 38. fish | 50. bowl |

Now tell your partner that you are going to *pronounce the sound of ten letters* (be sure not to pronounce the "names" of the letters, but their sounds; compare page 376 of your text) and that you want him unhesitatingly to write down, after each number from 51 to 60, one word which either begins or ends (preferably *begins*) with that particular speech sound. Again you pronounce both number and letter sound *whispering*, with your larynx wide open. However, altho whispering, put a considerable degree of *emphasis* on each letter sound. Compare your partner's list of ten words with your list of letters and draw your own conclusions. Blow your nose before you start.

- | | |
|---------------|---------------|
| 51. v | 56. j |
| 52. b | 57. d |
| 53. w | 58. m |
| 54. z | 59. n |
| 55. ga | 60. ng |

Now tell your partner to write down three more words beginning or ending with the three sounds you give

him. In this case you *not only whisper, but also hold your nose tightly closed.*

61. **m**

62. **n**

63. **ng**

And finally make him write one more word in the same manner. In this case, while *you do not whisper, you hold your nose tightly closed.*

64. **ng**

The student should carefully detach, when he needs them, the entry blanks following the index of this book, and use them in writing up the demonstration to which each belongs, *pasting* them (not pinning or clipping) in the report which he hands in to his teacher.

The Apparatus Needed for the Demonstrations described in this book is obtainable from *C. H. Stoelting Co.*,
3037-3047 Carroll Avenue, Chicago.

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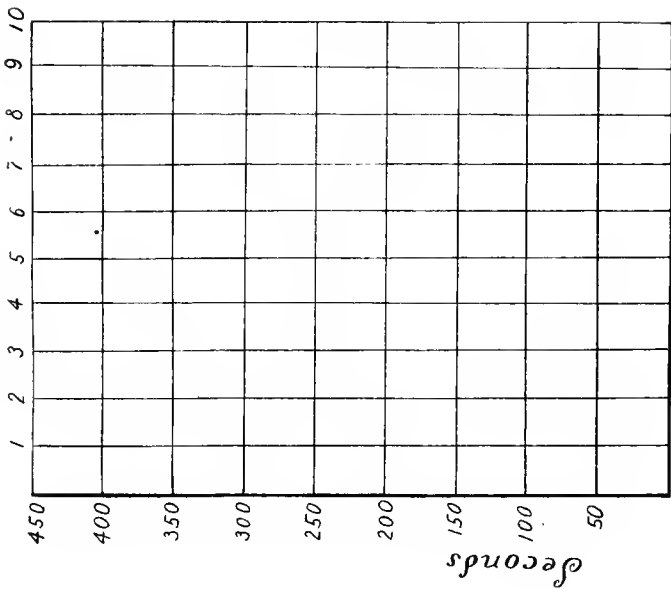
A blank graph paper with a grid. The vertical axis is labeled "seconds" and ranges from 0 to 450 in increments of 50. The horizontal axis is labeled "Errors" and ranges from 1 to 20 in increments of 1. The grid is 20 units wide and 9 units high.

Errors

To page 18.

<i>Grams</i>	<i>Ratios</i>	<i>Wrong</i>
	• •	
	• •	
	• •	
	• •	
	• •	
	• •	

To page 29.



Give each of the nine stimuli about ten times in irregular order. Record each judgment by making a little cross in the proper square. Paste this sheet in your note book. Translate your records into the table below. Finally make a general statement covering your results.

JUDGMENTS

	R	RB	RF	B	Above	F	LF	LB	L
STIMULI R									
RB									
RF									
B									
Above									
F									
LF									
LB									
L									

1. Lefts (L, LF, LB) regarded as Rights (R, RB, RF).....times. } Total.....
2. Rights (R, RB, RF) regarded as Lefts (L, LF, LB).....times. }
3. Fronts (F, RF, LF) regarded as Backs (B, RB, LB) or Above.....times. } Total.....
4. Backs (B, RB, LB) regarded as Fronts (F, RF, LF) or Above.....times. }
5. Above called Fronts (F, RF, LF) or Backs (B, RB, LB).....times.
6. Above called Rights (R, RB, RF) or Lefts (L, LB, LF).....times.
7. Above judged correctly - - -.....times.

1	25	1	25
2	24	2	24
3	23	3	23
4	22	4	22
5	21	5	21
6	20	6	20
7	19	7	19
8	18	8	18
9	17	9	17
10	16	10	16
11	15	11	15
12	14	12	14
13	13	13	13
14	12	14	12
15	11	15	11
16	10	16	10
17	9	17	9
18	8	18	8
19	7	19	7
20	6	20	6
21	5	21	5
22	4	22	4
23	3	23	3
24	2	24	2
25	1	25	1

F			
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